NI DIAdem™

Data Mining, Analysis, and Report Generation

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About This Manual

The manual *NI DIAdem: Data Mining, Analysis, and Report Generation* describe the structure of DIAdem as well as how to use the DIAdem functions to find data, to run analyses, to generate reports, and to compile all the functions into a script.

The first chapter provides an overview of the DIAdem structure. The subsequent chapters describe the functions of the individual DIAdem panels.

Related Documentation

For more information on DIAdem, refer to the following documentation:

*   *Getting Started with DIAdem*

    You can use the getting started guide to familiarize yourself with DIAdem functions and how to use them. This manual contains exercises for finding, analyzing, and presenting data, for combining all work steps in one script, and for executing a simple measurement.

*   *NI DIAdem: Acquiring and Displaying Data*

    This DIAdem manual describes how to use DIAdem to acquire data, to control sequences, to operate plants, and to visualize processes.

*   *You can open the DIAdem Help* in every dialog box with the **Help** button, on the toolbar with **Help»Contents**, or with <F1>.

    The DIAdem Help offers procedures and dialog box help for each panel, as well as references for programmers.

1

Working with DIAdem

DIAdem is the interactive National Instruments software for finding and managing technical data, mathematically and graphically analyzing the data, and presenting the data in reports. You search for data on your computer drives or on the network, and navigate in data files and databases to load data into DIAdem. You view the loaded data to decide on which data to run mathematical analyses. You present calculation results together with the raw data in a report. If you frequently use the same method to evaluate data, you create a script that automates evaluations.

DIAdem Panels

DIAdem consists of several panels. Use the panel bar on the left side of the DIAdem screen, to switch panels. Each panel deals with a particular type of task. You use DIAdem NAVIGATOR to mine and load data in different file formats. You use DIAdem VIEW to view data, to graphically analyze curve sections, and to edit data, for example, to correct errors. You use DIAdem ANALYSIS to evaluate data mathematically with standard functions or with your own formulas. You use DIAdem REPORT to create multi-page reports that document data and present results. DIAdem SCRIPT combines all the panel functions in scripts. You use scripts to create your own applications that process tasks automatically.

Figure 1-1. Panel Bar (Section)

All the panels work with the data that you load into the Data Portal. DIAdem VIEW, DIAdem ANALYSIS, and DIAdem SCRIPT can modify data and store the result data as data channels in the Data Portal. You can display and edit the contents of the data channels in channel tables in DIAdem VIEW.

DIAdem User Interface

When you switch DIAdem panels, the user interface changes so that you can quickly access the functions you want. Each DIAdem panel has its own group bar to the right of the panel bar. Click a button on the group bar and select a function from the function group that opens. The workspace also changes with the DIAdem panel and displays, for example, a folder and file overview or a worksheet. Each panel has its own toolbar, menus, and context menus, which contain frequently-used functions.

To create a report, select **DIAdem REPORT** on the panel bar. Click the **2D Axis Systems** group bar to open the function group with the predefined 2D axis systems. Click **2D Axis System with Frame** in this function group. The function group disappears and a small rectangle appears next to the cursor.

Figure 1-2. Predefined Function: 2D Axis System with a Frame
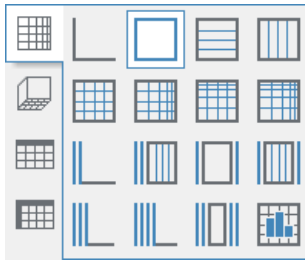
Click and drag open a frame at the position you want to insert the 2D axis system in the worksheet. Select the channels to be displayed in the Data Portal, and drag and drop the selected channels into the axis system. DIAdem displays the channels as curves. Double-click the axis system to open the dialog box for the axis system and define the display. The settings are grouped into subject areas on several tabs.

You can use the context menu to change the predefined settings for the functions in the function group. If you frequently calculate the arithmetic mean and the standard deviation, for example, change the predefined settings for the **Descriptive Statistics** function. Select the **DIAdem ANALYSIS** panel and click **Statistics** on the group bar to open the function group. Now right-click the **Descriptive Statistics** button. Select **Predefined Setting** from the context menu. Click **All Off** in the dialog box and select the two characteristic values **Arithmetic mean** and **Standard deviation**. Click **Change**. If you now click the **Descriptive Statistics** button, the arithmetic mean and the standard deviation are already enabled in the dialog box.

The bottom function group is the same in all the panels. You can assign your own scripts to the buttons of this function group and then call the scripts in all panels. You can also use the keyboard to call these scripts. For example, press <Shift–F1> to call the script assigned to the first button.

You can drag and drop one or more files from other programs, such as the Windows Explorer to DIAdem, in order to load these files in DIAdem. If you drag and drop files to the workspace of the active DIAdem panel, they must be file types that the panel can process. For example, you can load only TDV layout files in DIAdem VIEW and only TDR layout files in DIAdem REPORT. If you drag and drop files outside of the workspace onto the title bar, the menu bar, the toolbar, or the status bar, you can load any file type. DIAdem automatically opens the panel that matches the file type. If you drop a file onto the button of a DIAdem panel while keeping the mouse button pressed, DIAdem opens the panel and you can drop the file into the workspace.

DIAdem Introduction Screen

When you launch DIAdem, the DIAdem introduction screen appears. The introduction dialog box contains tutorials, executable examples, and DIAdem manuals. It also lists new features of the current version and contains links to further information.

If the introduction screen does not appear when DIAdem launches, select **Help»Introduction** to open the introduction screen. Use the **Don't show this screen again** checkbox to specify whether DIAdem displays the introduction screen the next time DIAdem starts.

- **Tutorials**: Open the website with the DIAdem tutorials and learn how to work with DIAdem. The videos show you how to work with the individual DIAdem panels.
- **Examples**: Click the preview pictures in the **Example Gallery** in order to open examples of DIAdem REPORT or DIAdem VIEW. Press <Ctrl> and click the preview picture to open the description of the example. The contents tree of the ExampleFinder contains simple solutions and also more complex applications on data analysis, report generation, script creation, and data acquisition. Copy the respective files to DIAdem to use these files as templates for your solutions.
- **Manuals**: Use the DIAdem manuals to familiarize yourself with DIAdem features and how to use them. You need a PDF reader such as Adobe Reader to open the PDF files.
- **Additional Resources**: Under this heading you find the **DIAdem Help** which helps you use functions and automate processes. You also can find the website for National Instruments **DIAdem Training Courses** and the website with the **DataPlugins**. DataPlugins are file filters for loading or saving file formats in DIAdem.

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The NI License Manager only enables functionality that is included in your license. For example, you cannot use the 3D functions from DIAdem ANALYSIS in the DIAdem Base Edition. Then the buttons of this function are dimmed. To use the 3D functions, you must obtain at least a license for the DIAdem Advanced Edition.

2

Finding and Managing Data

Use DIAdem NAVIGATOR to find, to load, and to manage data. You use the DataFinder to browse data files in different file formats on your computer and on the network. You use the file browser to navigate through external data in data files and in databases. You load the data you need into the Data Portal, which manages all internal data. The data in the Data Portal is arranged in channels, each representing a data series. All DIAdem panels work with the channels in the Data Portal.

Figure 2-1. DIAdem NAVIGATOR
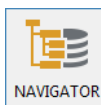
Mining External Data

In DIAdem NAVIGATOR you use the DataFinder to browse data files on your computer and on the network. In the search results, DIAdem lists the files, channel groups, or channels it finds. You can drag and drop this data into the Data Portal or navigate in the files with the file browser.

To find data from a series of tests or data relating to a specific subject, enter an appropriate search term in the search input area. If you search for meteorological data, for example, enter `Precipitation` in the search input area if the data set you want contains the term `Precipitation` as a channel name or in the comments. DIAdem browses through all the data files for the text `Precipitation` and lists the data files it finds on the **Search Results** tab. Refer to *Configuring DataFinders* in this chapter for information on specifying the folders that the DataFinder searches.

The properties display below the search results displays the properties of a selected file, selected channel group, or selected channel. Click one of the files to view the file properties. In the properties display, DIAdem displays file properties such as the filename, path, creation date, name, and author. Drag up the top edge of the properties display to view the entire properties list.

To browse in the files, right-click the file in the search results and select **Display in File Browser**. DIAdem opens the file browser and selects the file. The file browser offers a tree view of the folders which you searched. You can navigate down to channel level in the folders that have the appropriate file formats.

If you navigate in a file down to channel level, DIAdem displays the channel data as a curve in the channel preview. For example, select a channel in a TDM file to display the channel values

as a curve in the channel preview on the right edge of the properties display. Drag the right edge
of the properties display to the left to enlarge the channel preview.

Extending the Search

To define a detailed search, click **Advanced Search**. You can enter several search conditions in
the search input area. You can search for files, channel groups, and channels, because the
Advanced Search is based on the TDM data model. For example, if you search for
meteorological data that includes a channel called `Precipitation` and that is more than
one month old, specify two search conditions in the search input area. As soon as you specify a
search condition in one line, DIAdem automatically creates a second line. To view all the search
conditions, drag the bottom edge of the search input area down.

Click in the first line of the entry field under **Level** and select `Channel`. Click **<Enter a
property>** in the **Property** column and select `Name`. Click the third column and select
the = operator. Click the button with the three dots at the end of the first line. DIAdem lists the
names of all the indexed channels. Enter the letter `P` under **Search in list** and select
`Precipitation`. DIAdem enters the channel name `Precipitation` in the **Value** column.

In the second line, select `File` in the **Level** column and select `Creation date` in the
Property column. In the third column, select `Date before <=` as the operator. In the **Value**
column, first click the displayed date and then click the button with the arrowhead to open
the calendar. Select a date that dates back at least one month. If you click the button with the
three dots at the end of the second line, DIAdem displays the time range of the creation date for
all the indexed files.

Click **Search** to find files that match both search conditions. DIAdem lists the files it finds on
the **Search Results** tab. You can also search for channel groups and channels. If you want to find
channel groups that match the specified search conditions, click the little triangle on the **Search**
button and select **Search Groups**. On the **Search Results** tab, DIAdem lists channel groups
containing a channel called `Precipitation` and files with the specified creation date. If you
want to view the corresponding channels in the results, select **Search Channels**.

The search results display the names of the located files, channel groups, or channels, and also
the path and the properties used in the search, for example, the creation date. To display more
information, drag another property, for example, the channel minimum, from the properties
display into the search results of the found channels. DIAdem adds a column with the channel
minimum values to the search results. Click **Channel.Minimum** to move the column in the
search results list. Click the two triangles on the right side of the column title to sort the channels
in ascending or descending order according to the channel minimum values. Select **Configure
Results List** from the context menu to edit the display of the properties.

The logical operations line below the search conditions displays the logical connectives of the
individual search conditions. DIAdem numbers the search results from the top down with `C1` to
`Cn` and connects the search conditions with the `AND` operator. If you search for two values of one
property, use the `OR` operator to link the values. If you enter several channel names in the **Value**
column, DIAdem automatically uses `OR` to link the names. You can use the logical operations

line to search simultaneously for files that contain the channel `Name1` (search condition C1) or `Name2` (search condition C2), and which are not older than one day (search condition C3):

```
(C1 OR C2) AND C3
```

Entering Search Conditions

If you enter text in the search input area of the **Quick Search** or in the **Value** column of the **Advanced Search**, DIAdem automatically displays a list of the previous entries that start with the same letters. You can enter the search text in uppercase or lowercase because the DIAdem search is not case-sensitive.

In the **Quick Search**, you can also search for fragments if you do not know the complete filename or if the filenames all start with the name of a test series. For example, enter the fragment `tr_m17_qt` for a test series in which the test program automatically generates the filenames of the measurement results from the test series identification. DIAdem finds all the data sets that have the fragment `tr_m17_qt` at the beginning of a name or at the beginning of another property.

In the **Advanced Search**, you must use wildcards to search for fragments. Use a question mark (`?`) as a wildcard for one character, and an asterisk (`*`) as a wildcard for any number of characters. For example, to search for the fragment `m17`, enter `*m17*`. DIAdem finds all the data sets that have the fragment `m17` at the beginning, in the middle, or at the end of a property. If you search for files with a specific filename extension, enter `*.TDMS`, for example, for the filename.

In the **Advanced Search**, depending on the type of property you search for, you can use the various operators listed in the following table. For text properties, such as `Name`, you use the = operator, and for numeric properties, such as `Maximum` values you use the usual comparative operators. For date properties, such as `Creation date`, you can use the # operator with `Relative range`, where you can select today, yesterday, the last 7 days, the last 14 days, or the last 30 days.

Table 2-1. Where to Use the Operators in an Advanced Search

Operator	Meaning	Numeric	Date	Text
=	Equal to	✔	✔	✔
<>	Not equal to	✔		✔
>	Greater than	✔		
>=	Greater than or equal to	✔	✔	
<	Less than	✔		
<=	Less than or equal to	✔	✔	
#	Relative range		✔	

If you load data from a test series into the Data Portal and you want to find and compare more data sets from the same test series, you can drag and drop a file, a group, or a channel from the Data Portal into the search input area. DIAdem enters the name of the file, of the group, or of the channel as a search condition. You can also drag and drop properties from the properties display of the Data Portal or of the file browser into the search input area.

If you select several channels in the Data Portal and drag these channels into the search input area, DIAdem combines the channel names with the OR operator and creates a search condition. If you then drag a property such as the maximum value from the properties display of the Data Portal into the search input area, DIAdem combines the maximum values of these channels with OR to a second search condition. If you look for channels of a test series with a maximum value of, for example, between 4 and 12, you must define two search conditions. Combine the search conditions `Maximum>4` and `Maximum<12` in the logical operations line with AND.

If you define a query you want to use later, you can save the entries of the current search with **Save Query As**. DIAdem saves the parameters of the current query together with the configuration of the search results list in a file with the filename extension `.tdq`. Use **Load Query** to load saved queries or the configuration of the search results list, or both. Click **Delete Query** on the toolbar to specify a new query in the search input area. Click **Previous Query** or **Next Query** on the toolbar if you want to reuse a previous query. To delete individual search conditions from a query, select the search condition and press <Del>. The next time you start DIAdem, the search input area contains the query you entered last. If you want to change this setting, click **Settings»Current Data Provider»Default Settings** and specify that DIAdem does not show a query, or that DIAdem reads the query from a file when the program opens.

Configuring DataFinders

You execute the searches described above with the local DataFinder **My DataFinder**, which is located on your computer. You install the local DataFinder with DIAdem. The **DataFinder** function group contains **My DataFinder** and three more buttons to which you can assign DataFinder servers if you use the **Predefine Setting** in the context menu.

Configuring the Local DataFinder

Use **My DataFinder** to search folders on your computer with the local DataFinder. You cannot delete the local DataFinder and you cannot create additional local DataFinders. To edit the settings of the local DataFinder, select **Settings»My DataFinder»Configure**. In the configuration of the local DataFinder you specify the search areas and the indexing of the data files. You can also see which file formats the DataFinder includes in the search.

Search areas are the file system folders in which the DataFinder searches for files. Select these folders on the **Search Areas** tab. You can add and delete folders, exclude subfolders from the search, and change the order in which DIAdem displays the search areas in the file browser. You can also use the context menu of the file browser to create and to limit search areas. For example, if LabVIEW is installed on your computer, the `LabVIEW Data` folder is in the default search area `My Files` or `My documents`. However, the folders `My Pictures`, `My Music`, and `My`

Videos are not included in the search area because these folders do not usually contain data relevant for the DataFinder.

The DataFinder only can search files in the search area if the DataFinder indexes the files first. Click the **Indexer** tab in the DataFinder configuration dialog box to specify when and how often the DataFinder indexes the search areas. In the file browser, DIAdem displays an hourglass next to files and search areas that the DataFinder has not yet indexed.

The **File Extensions** tab has two lists that contain all the filename extensions that the local DataFinder recognizes. The **Indexable extensions** list shows all the indexable file types that correspond to the TDM data model. In indexable files the DataFinder can search for properties of data sets, groups, and channels. If the data is indexed, DIAdem can navigate to channel level. Click a filename extension to see which DataPlugins **My DataFinder** uses to index these files. If several DataPlugins are available for one data format, you specify the sequence of the DataPlugins. The **Non-indexable extensions** list shows all the non-indexable file types. These file types do not correspond to the TDM data model. In non-indexable files, the DataFinder cannot search for properties of groups or channels. The DataFinder only can search for properties that the file system provides, such as the filename and the creation date. Specify which DataPlugins the DataFinder uses on the **DataPlugins** tab.

You can search for properties in data files, as well as in documents and in graphics. You can search for basic properties such as filename, description, title, author, and storage date, and also for custom properties. If you want to search for a custom property, for example, the name of a test sequence, it must be created first when exporting a report. If you drag one of the documents you found onto the root in the Data Portal, the properties display lists all document properties. If DIAdem is not able to search in documents and graphics, check under **Settings» Extensions»DataPlugins** whether a DataPlugin for documents is registered.

You can optimize the search for custom properties for the local DataFinder. Custom properties are user-defined properties that you can create for data sets, groups, and channels of the data that is saved in the TDM data model. Open **Settings»My DataFinder»Optimize Custom Properties** and select the custom properties to be optimized on the tabs **File**, **Group**, and **Channel**. DIAdem lists these custom properties in the selectable properties of the **Advanced Search**. If you select an optimized custom property, click the button with the three dots at the end of the entry field to include a suggested value in the search. You only can search for Date type custom properties if these custom properties have been optimized.

Generally, you should not change the index location in which **My DataFinder** saves the index, and which is set up during installation. However, if the drive with the index has less than 20 MB free memory space, the DataFinder server stops indexing and displays an error message. You must then either delete files to make more space available, or change the index location as follows. Open **Settings»My DataFinder»Configure»Advanced** and change the **Index location**. If you change the index location, the DataFinder reindexes the search areas.

If you delete large search areas or if the DataFinder can no longer access its index, the DataFinder must create a new index. To do so, select **Settings»My DataFinder»Reset** and delete the previous index. Indexing the search areas may take some time.

In the bottom right corner in the information area of the Windows task bar, you can open the context menu of the registered My DataFinder. At this point you can configure or close every My DataFinder, stop or restart indexing, and also reset the index. Select **About My DataFinder** to see when the last complete indexing was executed and how many files, groups, and channels are indexed.

DataFinder Server

Use **TDM Server** to install DataFinder servers on a network server in order to index files in the network. DIAdem communicates as a client with DataFinder servers in order to search the index and to load the files it finds. In TDM Server you can specify several DataFinder servers in order to separately index the data areas of different work groups. You cannot do this with My DataFinder. DataFinder servers index faster because of the parallel processes and manage larger volumes of data because of the more powerful database connections.

Use TDM Server to find and to analyze data on other computers and central servers in the network. To register a **DataFinder Server** in DIAdem, copy the client configuration created by TDM Server onto your computer. TDM Server saves the connection parameters in a file with the filename extension `.urf`. Double-click this URF file to register the connection parameters and the DataPlugins on your computer. Use **Settings»DataFinder Server** to import, configure and delete further DataFinder servers.

Use the context menu to assign one of the free buttons in the **DataFinder** function group to this DataFinder server in order to access the DataFinder server quickly. If you click this button, DIAdem opens the search areas of the DataFinder server in the file browser. In the search areas of the DataFinder server, you can search, navigate, and drag and drop the data into the Data Portal. You can test the connection to the DataFinder server in DIAdem in **Settings»DataFinder Server** and, if necessary, change the connection parameters.

If several work groups access the central data areas of a network server, you can use the Windows user accounts to manage the access rights of clients to the DataFinder server and data. TDM Server uses Windows access rights so that members of a work group can search for and load data only in the shared folders.

You can use DataFinder servers as an ASAM ODS Server in order to read the data through the Corba interface of ASAM ODS. The ASAM ODS interface makes it possible to connect ASAM conform programs as clients with this server. If you register the connection settings on a DIAdem computer, DIAdem can either access the data from the DataFinder server directly or can open the data as ASAM ODS data in the file browser in DIAdem NAVIGATOR. Register the DataFinder server under **Settings»Data Stores** as a data store in order to use the DataFinder server as an ASAM ODS server in DIAdem. The data browser in DIAdem NAVIGATOR uses a model hierarchy configured on TDM Server to display the data.

Navigating in Data Stores

DIAdem NAVIGATOR displays external data stores as a hierarchical structure. You can navigate in data stores on your computer, on connected drives in the network, and in every registered database, in order to drag and drop individual channels and channel groups into the Data Portal. In the **Data Stores** function group in DIAdem NAVIGATOR, you can register file-based data stores and server-based data stores.

To load an example for ASAM data, click **ASAM Pass Fail Analysis Example**. DIAdem NAVIGATOR opens the ASAM example database in which you can browse in tests, measurements, matrices, and submatrices and drag and drop data into the Data Portal. A level which you can load into the Data Portal has a colored symbol in the file browser and, when it is selected, is highlighted in color. The ASAM model allows the definition of further levels such as engine, test condition, or operator, the display of which you can define and save in the file browser by clicking **Settings»Current Data Provider»Browse Settings**.

When an ASAM data store is open in the file browser, you can search in the data. You specify the level, such as `TestRun`, the property, such as `Name`, the operator, and the value searched for, such as `TR_M17_QT_33*`. You can search for TestRun, Measurement, and Meaquantity and configure the search results list in order to, for example, show a test description.

Adding Data Stores

Settings»Data Stores lists all data stores available in DIAdem. Double-click a data store in order to open it in DIAdem NAVIGATOR Select **Create Data Store** to access further data stores in DIAdem and then, for example, the data store type **AOP** to register an ASAM database. Enter your user name and password, and the server for the ASAM database. Assign this database and further data stores to buttons in the **Data Stores** function group in order to have fast access to frequently used data stores.

Loading Data from Files and Data Stores

You drag and drop files, channel groups, or channels from the file browser and from the search results into the Data Portal. If you drag a file, a channel group, or channels onto the root element of the Data Portal, DIAdem deletes the internal data and loads the new data. If you drag a file or a channel group to another position in the Data Portal, DIAdem generates new groups with the loaded channels. If you drag single channels into the Data Portal, DIAdem adds the channels to the group you worked with last.

When you drag and drop data into the Data Portal, DIAdem automatically uses the loader associated with the file type. If DIAdem cannot automatically load a file, a dialog box opens in which you specify the loader. Click **Open With** to see which file formats your DIAdem installation can load. To do so, disable the setting **Display only Plugins with same extension**. Select, for example, **Import Wizard Text** to load a specfic text format with this wizard.

Click **Search** to find and load a loader on the NI DataPlugin website if DIAdem does not have a loader for a specific file format. If DIAdem does not have an appropriate loader on the DataPlugin website, you can create a DataPlugin for the specific file format. Click **Wizard** to open the DataPlugin wizard. A DataPlugin is based on a VBS script that analyzes files of a specific type and provides the data for DIAdem.

To refresh the DataPlugins available in DIAdem and to add further DataPlugins, open **Settings»Extensions»DataPlugins** and click **Update**. This dialog box contains all DataPlugins registered in DIAdem. You can import DataPlugins, export them encrypted to a different computer, and also create new DataPlugins, for example, for your documents. For more information about DataPlugins, refer to the section on *Creating DataPlugins* in Chapter 6, *Automating Sequences*.

In earlier versions, DIAdem loaded all the data from a file to an internal storage area. Files with numerous and long channels took some time for this. Now DIAdem does not load the bulk data of a channel until you write to it for the first time. You can change the loading behavior by clicking **Settings»DIAdem Settings»NAVIGATOR**. For faster processing of large files, only register the channels in DIAdem or execute reduced loading on data from long term measurements.

To register data in DIAdem, right-click the file in the file browser and select **Register Data** from the context menu. DIAdem creates write-protected channels in the Data Portal that refer to the data without loading the data into the internal memory. To edit a registered channel you must load the data later with the function **Expand Channel** from the Data Portal context menu.

For reducing loading of large files in which the consecutive values differ only slightly, select **Data Reduction** from the context menu in the file browser. You specify the width of the interval that DIAdem applies to each data channel in order to load one value from each interval. You can load the first value from each interval or you can calculate the mean, the maximum, or the minimum for each interval. If you use several reduction methods simultaneously on one channel, DIAdem creates a new data channel for each reduction method.

Use, for example, the Bus Log Converter to convert logfiles from CAN, LIN, and FlexRay buses into the TDM format and to load them into the Data Portal. The CAN bus (Controller Area Network), LIN bus (Local Interconnect Network), and FlexRay bus are used for the communication of intelligent sensors and actuators in vehicles. The data packages transported in the bus are saved in bus logfiles. In order to interpret the data packages, the converter also needs the descriptive information from a database file, such as NI-CAN (`.ncd`) or LIN signal description (`.ldf`). Use the buttons in the **Bus Log Converter** function group to simplify the conversion of logfiles with specific database files. To convert into the TDM format, connect the logfile with at least one database file. You save the settings necessary for the conversion of a logfile in a user file with the filename extension `.tcc`, which you assign in the **Predefine Setting** context menu of a button.

Managing Internal Data in the Data Portal

The Data Portal manages the data that you load in DIAdem NAVIGATOR. All panels in DIAdem work with the internal data from the Data Portal. The Data Portal contains numeric channels, waveform channels, time channels, and text channels. The Data Portal organizes the channels in groups and displays the properties. The channel preview in the Data Portal displays the channel data as a curve and can play acoustic data saved in waveform channels on the computer loudspeakers. DIAdem only temporarily loads internal data from the Data Portal into the workspace. DIAdem does not store the changes you make to the internal data until you save the data to a file or to a database.

Working with Channels

DIAdem organizes data in channels: a numeric channel contains measurement values from a sensor, and a time channel contains the associated time values. All DIAdem panels work with channels. In DIAdem ANALYSIS you can calculate, for example, an FFT from two channels with time and amplitude values, and in DIAdem REPORT you display a channel as a curve above the channel index.

Create channel groups to organize channels in the Data Portal. When you drag and drop a data file from DIAdem NAVIGATOR into the Data Portal, DIAdem creates new channel groups. Channel groups help you prepare and describe data for evaluation and presentation. For example, a `Results` channel group can contain all the calculated result channels.

DIAdem designates the last channel group that you load into the Data Portal as the default group. DIAdem stores result channels for which you do not specify a channel group, such as the channels calculated in DIAdem ANALYSIS, in the default group. DIAdem displays the group name of the default group in bold in the Data Portal. For example, use the context menu to designate the channel group `Results` as the default group, and smooth the channel `SensorData`. DIAdem saves the result channel `Smoothed` in the `Results` default group.

Use the context menu in the Data Portal to edit the internal data. You can generate and delete channel groups and channels, change the names of channel groups and channels, and move or copy channel groups and channels. The structure view of the Data Portal orders channels in channel groups, whereas the list view lists all channels in tables according to a selected property. If you want to delete all data from the Data Portal, click **Delete Internal Data** on the toolbar or select **Delete** from the context menu of the Data Portal root.

Use filtering and pinning to display only specific groups or channels in the Data Portal. Click **Filter** to open the filter area. If, for example, you only want to display the acoustic measurement channels, enter `NOISE` as a filter condition. While you enter the letters, the Data Portal already displays those channels with names starting with these letters. To filter channels that contain a certain character sequence in the name, use the question mark (`?`) for one, and the asterisk (`*`) for several optional characters. You can define group filters and channel filters, which must both be fulfilled, and you can link several filter conditions with `OR`. The filters are not case sensitive and are not effective when the filter area is closed. To exclude groups and channels from

filtering, use the context menu to pin groups and channels. Groups and channels that are pinned are always displayed. In the context menu you can select the pinned channels or show the pinned channels and groups only.

When DIAdem accesses channels in an axis system or in a calculation, the channel is normally referenced by the group index combined with the channel name. Select **Settings»DIAdem Settings»General** to specify the channel reference as another combination of the group name or the group index and the channel name or the channel index. The group index is the position of the group in the Data Portal and the channel index is the position of the channel in the group. Refer to the section on *Calculating with Channels* in Chapter 4, *Analyzing Data with Mathematical Functions* for more information about channel references.

Creating New Channels

The DIAdem panels create new channels for different actions. DIAdem NAVIGATOR creates new channels when you load data. In DIAdem ANALYSIS, calculations store results in new channels. In DIAdem SCRIPT you create new channels with script commands.

In DIAdem VIEW you can also create channels manually. Select **Create New Channel** from the context menu of a channel table. You can enter single channel data in the channel table or you can use the **Generate** function to create data series. To create a channel group, select **New» Group** from the context menu of the Data Portal. You cannot use the same name twice for channel groups or for channels of one channel group. If you enter a name which is already used, DIAdem automatically adds an index and a separator to this name in order to ensure the uniqueness of the name. You can change this behavior in **Settings»DIAdem Settings»General**.

Numeric Channels, Waveform Channels, Time Channels, and Text Channels

DIAdem works with different channel types: numeric channels, waveform channels, time channels, and text channels. The symbol that DIAdem displays before the channel in the Data Portal identifies the channel type.

Numeric channels contain acquired values, calculation results, input values, or values loaded from files. DIAdem can use any numeric channel from the Data Portal for calculations and displays.

Waveform channels contain the x-part and the y-part of a curve in a channel. The x-part is often the time information that LabVIEW, for example, saves as a linear generation specification with a start value and a step width. The y-part can include measured values, calculation results, or input values. If you use waveform channels as the y-channel in calculations and curve displays, you do not need to specify an x-channel.

Time channels contain absolute time values of a measurement. In a time channel, DIAdem saves the seconds that have elapsed since the year zero up to the current time. Use the **Generate Time Channel** function in DIAdem ANALYSIS, for example, to create time channels. A time channel

is often the x-channel for calculations and for displays of the associated measurement values. DIAdem saves relative time values, such as the duration of a test in seconds, in numeric channels.

Text channels contain text, for example, observations and comments. DIAdem saves text channels in Unicode. Unicode characters include Chinese, Japanese, and Arabic characters. Use text channels in tables and in 2D axis systems in DIAdem VIEW and DIAdem REPORT. You can edit text channels in DIAdem VIEW channel tables.

Organizing 2D Data and 3D Data

DIAdem works with single channels. To display curves in DIAdem VIEW and in DIAdem REPORT, use one or more channels. If you drag and drop one channel into a 2D axis system, DIAdem uses the index to display a numeric channel and uses the x-part to display a waveform channel. If you drag and drop several channels into a 2D axis system, the first channel selected in the Data Portal is the x-channel of the curves. Even if an axis system already displays a curve, you can still select one or more channels in the Data Portal and add more curves to the axis system.

DIAdem REPORT and DIAdem ANALYSIS read data as a matrix or as a triplet to display three-dimensional data. DIAdem uses three channels that are the same length to make a value triplet: one channel for the x-values, one channel for the y-values, and one channel for the z-values. A DIAdem matrix consists of an x-channel, a y-channel, and several z-channels. The number of z-channels corresponds with the length of the y-channel and the length of the z-channels corresponds with the length of the x-channel.

Editing and Creating Data Properties

In the TDM file format, DIAdem saves properties and comments with the bulk data. For example, the data set properties in DIAdem contain the name of the author and the storage date, the channel group properties contain the name of the measurement and comments, and the channel properties contain the data type and the unit for the channels. DIAdem uses the data properties to manage the data. The DataFinder indexes the properties, which enables you to search for data efficiently.

In the structure view, DIAdem displays the properties of the data in the bottom area of the Data Portal. If the properties do not appear in the Data Portal, click the bottom edge of the Data Portal and drag open the properties window. If you click the root of the tree view in the structure view, you see the data set properties. If you click the name of a channel group, you see the properties of the channel group. If you click a channel name, you see the channel properties.

The Data Portal organizes the properties in groups. A data set, a channel group, and each channel has base properties. But channels also have extended properties. Click the plus sign before the **Base Properties** to show the individual properties. Double-click a property field to edit the property. Properties you cannot change, such as maximum and monotony, are dimmed. Properties that you can change, such as name and unit, are in black font.

In the Data Portal you can add additional properties to channels, channel groups, and the data set. Use custom properties to provide data with additional characteristics not included in the standard data model, and which the DataFinder can search for. Right-click a channel and select **New»Custom Property** from the context menu to create a new property for this channel. Enter a name and select the data type. The property appears in the structure view and in the properties display of the Data Portal. Click the entry field in the property display and enter a value for the new channel property.

To ensure that every new channel or every new channel group always receives specific custom properties, such as the sensor type or the component part number, you can create a template for the custom properties. Select **Settings»DIAdem Settings»General** to create a template for the custom properties of channels. Select the checkbox **Data Portal»Template for custom properties** and click **Edit**. Select the **Channel** tab and click **New Entry** to specify the name for a custom property and to select the data type and the initial value. The Data Portal creates the new group **Custom Properties** in the structure view.

By default, DIAdem only reads the properties of the elements that you load into the Data Portal from a file or a data store. When loading channels, DIAdem only accepts the associated channel properties. You can change this loading behavior by clicking **Settings»DIAdem Settings» NAVIGATOR**, so that the element loaded into the Data Portal inherits properties from superordinate elements. When loading channels, DIAdem can, for example, add channel group properties or data set properties to the loaded channels.

Using the Units Catalog

If you click the input field of the channel unit in the Data Portal, you can select a different unit when you click the button with the three dots at the end of the input field. For example, select the unit miles per hour `[mi/h]` to change a velocity that was saved in the unit kilometer `[km/h]`. If you click **Convert**, DIAdem converts the channel values to the new unit. If you click **Replace**, you use the new unit without DIAdem having to recalculate the channel values.

DIAdem manages the channel unit in the units catalog. The units catalog assigns a physical quantity and a unit to measurement values, for example, the quantity speed and the unit kilometers per hour. Other physical quantities are length, volume, mass, or frequency. Usually every quantity has several units, for example, to specify the length in meter, centimeter, foot, or inch. Every unit has a symbol such as `[cm]` for centimeter. DIAdem groups quantities into unit sets. By default, DIAdem uses the SI unit set (SI: Système international d'unités). However, you can also select a different unit set, for example, the unit set with the country specific units.

Select **Settings»Units** to open the DIAdem units catalog. The **Unit Sets** tab lists the available unit sets. If you want to view and to extend the SI unit set, select this line and click the **Quantities** tab. This tab lists all the quantities that are defined in the unit set with the respective basic units, for example, length in meters, time in seconds, or temperature in Kelvin. Every quantity is followed by the dimension, which refers each quantity to the seven basic quantities length, mass, time, electric charge, thermodynamic temperature, amount of substance, and luminous intensity. Use multiplication and division of the basic quantities to create new

quantities. Enter integer exponents such as `2,0,0,0,0,0,0` for a surface as the product of two lengths or `1,0,-1,0,0,0,0` for a speed as the quotient of length divided by time.

Select the quantity **Length** and open the **Units** tab. This tab lists all the units that are defined for the quantity length. Select a default unit such as meter, in the **Default** column. If you create a new unit, enter the name, the symbol, and the scaling function for the conversion to the basic unit, for example, `Ell` with the symbol `E` and the conversion factor `1/3`. This makes three ell as long as one meter. Use the factor, the offset, linear scaling, or logarithmic scaling to specify how DIAdem converts the new unit to the basic unit.

Save the units you changed. DIAdem saves the units catalog in a file with the filename extension `.tuc`. You can import units from other units catalogs or import the other units catalog completely.

Saving Internal Data

To save the internal data from the Data Portal, click **Save TDM File As** in the Data Portal toolbar, or drag the data to be saved into the file browser. To save all internal data, click the root in the structure view and drag and drop the data set into the file browser. To save selected channels, select the channels and channel groups you want to save, and drop the selected channels into the file browser. DIAdem saves the data in the folder into which you drop your internal data in the file browser. If you drop data into a data file, DIAdem suggests this filename for the new data file in the **Save As** dialog box. DIAdem does not create the new data file until you click **Save**.

Remove the write protection from a file because you cannot overwrite a protected file. To do so, select **File Operations»Write Protected** from the context menu of the target file in the file browser. The file operations in the file browser also include copy, move, rename, and delete.

By default DIAdem saves data in TDM file format. The TDM file format saves the properties and the binary data in different files with the same name. DIAdem saves the data properties in a text file with the filename extension `.tdm`, and the numeric data in a binary file with the filename extension `.tdx`. When you save TDM files under **Settings»DIAdem Settings»NAVIGATOR**, you can specify that DIAdem automatically specifies the storage format of the numeric data to save memory space. For example, DIAdem saves the loaded integer data as integer values if they have not changed.

In addition to the TDM format, the **Save As** dialog box also offers file formats that save the data for which a DataPlugin with write functions is registered in DIAdem. Select the TDMS file format to save binary data with the respective properties in one file for LabVIEW. LabVIEW can append measured data to an existing TDMS file. If you want to evaluate TDM data and TDMS data with Microsoft Office, use the NI TDM Excel Add-In, which converts the data of the Data Portal into the structure of the Excel spread sheets.

3

Analyzing and Editing Data Graphically

Use DIAdem VIEW to inspect the data in the Data Portal, to graphically analyze curve sections, and to edit data. You inspect curves in axis systems, zoom curve sections, and delete or replace curve points. In channel tables, you edit and delete single values or entire channels. If you modify curves or edit channels, DIAdem saves the changes in the Data Portal.

If you record test videos or the route of a test drive simultaneously with the data, you can synchronize the curves with the videos and the geographical data. If you inspect a component, you can project the signals measured at various positions or simulated data, onto a model of the component as color shading or as deformation. You can display characteristic diagrams as color shading and with isolines.

Figure 3-1. DIAdem VIEW

Worksheet Design

You can combine various axis systems, channel tables, videos, maps, 3D models, contour displays, dialog boxes, text, and graphics in one worksheet in DIAdem VIEW. To do this, you partition the worksheet. The function groups contain predefined worksheet partitions with different numbers and area arrangements.

For example, if you want to display data as a curve in a 2D axis system and list the associated numeric values in a channel table, divide the worksheet into two areas. Open the **Assigned Worksheet Partitions** function group and click the **2D Axis System/Horizontal Channel Table** button. DIAdem inserts an axis system in the top area and a channel table in the bottom area.

Figure 3-2. Assigned worksheet partitions

To display a curve, select a channel in the Data Portal and drag and drop the channel onto the 2D axis system. DIAdem VIEW displays numeric channels over the index and displays waveform channels over the x-part.

To display one or more curves over one x-channel click the x-channel first in the Data Portal, for example, `Time`. Then press Ctrl and click the numeric y-channels, for example, `Pressure` and `Temperature`. Drag and drop these channels onto the 2D axis system. DIAdem VIEW displays the pressure and the temperature as curves over time. If you drop a channel group onto an axis system, DIAdem selects the first channel in the channel group as the x-channel. If you drag and drop several waveform channels onto an axis system, DIAdem displays each waveform channel over its x-part.

To list data in channel tables, select the channels, a channel group, or the data set in the Data Portal, and drag and drop the data into the channel table. DIAdem VIEW lists each channel in a column, with the channel name as the heading.

Editing Layouts

You can load a prepared layout as a template. The layout file contains the description of all the areas and references to the channels, videos, or graphics to be displayed. Layout files can contain several worksheets and have the filename extension `.tdv`.

You can drag the separating bars to resize any area in a worksheet. However, you cannot move areas to another position in the worksheet. To add new areas, use the context menu to split an area, or select different worksheet partitions with more areas. If you select worksheet partitions with fewer areas, the contents of the surplus areas are deleted. If you select one of the worksheet templates in the **Assigned Worksheet Partitions** function group, DIAdem creates a new worksheet that contains areas with specific display types.

Use the context menu to specify and to change the display type of the area. To define an area as an axis system, right-click the area and select **Display Type»2D Axis System** from the context menu. If you select the display type **Channel Table** for an axis system, DIAdem lists the values of the channels that are displayed as curves in a channel table.

Which options the DIAdem VIEW context menu contains, depends on where you right-click. For example, to insert another worksheet right-click the name of a worksheet on the tab bar and select **New** from the context menu. Select **Manage** to change the order of the worksheets or to rename the tabs. To insert worksheets from an existing layout, select **File»Append Layout**.

To document the current view of your data in a report, you can transfer your worksheet to DIAdem REPORT. Click the **Transfer to REPORT** button on the DIAdem VIEW toolbar. DIAdem REPORT creates a new worksheet with 2D axis systems, tables, video frames, 3D models, map sections, and dialog boxes in the same layout as in the DIAdem VIEW worksheet. DIAdem REPORT offers extensive functions for the final presentation and documentation of your results.

Entering and Editing Data in Channel Tables

Use the **Channel Table** display type to edit and to display the contents of numeric channels, waveform channels, text channels, and time channels, and to enter new values. The channel table displays channels columnwise. The table heading includes the channel properties, such as the channel name and the channel length. Use the mouse wheel to scroll vertically through the displayed table columns. Press <Shift> at the same time to scroll horizontally through several table columns or press <Ctrl> to zoom the channel table.

To move channels in the table or to remove channels from the table, select a column in the table by clicking above the first channel property. Click a cell in the channel table to delete or to overwrite the contents. Double-click a cell to edit the contents. If you select several cells in one column or in neighboring columns, you can select the **Block Operations** from the context menu to edit the data block.

In the channel table you can create new channels and fill the channels with values. Select **Create New Channel** from the context menu. Enter a channel name and specify the display format, for example, **Numeric**. DIAdem creates the new numeric channel in the default group of the Data Portal and inserts the channel into the channel table at the same time. You can now enter channel values or use the **Generate** function in the context menu to generate data series.

Select **Display** from the context menu to specify which channels from the Data Portal DIAdem VIEW displays and refreshes automatically, for example, after a calculation. The channel table can display all the channels of the Data Portal, a specific channel group, or only the selected channels. To display other channel properties, such as the maximum value or user-defined custom properties, in the table heading, select **Select Properties** from the context menu. You can select a property, such as **Maximum** in the properties display of the Data Portal and drag and drop the property into the channel table.

Viewing Data as Curves

Use axis systems to display data as curves. If the x-channel and the y-channel in a 2D axis system are not the same length, the shorter channel determines the curve length. Double-click the axis system to open the **2D Axis System Display** dialog box, where you add, copy, modify, or delete curves. You can highlight curve points with markers and label them with text or values.

You change the x-axis scaling and the y-axis scaling individually on the toolbar of the axis system. You can use logarithmic or linear scaling for the axes. In order to compare curves with different y-value ranges in an axis system, you can select a common y-axis with a percentage scaling or select a separate y-axis for each curve.

Use the mouse to drag open the legend on the right side of the axis system. The legend displays the y-channel name for each curve and two checkboxes. The checkbox that has the same color as the curve specifies the leading curve, which you analyze later. The second checkbox determines which curve DIAdem displays in the axis system. The legend can display other channel properties, such as extreme values or the cursor coordinates. To configure the legend, select **Legend** from the axis system context menu.

To copy curves to another axis system, click next to the checkbox of the curve and drag and drop the selected checkbox to the other axis system. Press <Del> to delete the selected curves. DIAdem also displays these checkboxes when you load a layout with curve definitions that contain channels that are not in the Data Portal. To delete all the curve definitions that cannot be displayed in the axis system, select **Delete Invalid Curves** from the context menu.

Zooming Curve Sections

To enlarge and inspect curves in an axis system, select the band zoom or the frame zoom on the toolbar of the axis system. Click **Zoom In** to increase the zoom stepwise and **Zoom Out** to undo the zoom steps. Click **Zoom Off**, to see the whole curve again. Use the **Move** function to move the enlarged section horizontally and to move the frame zoom vertically in the axis system.

To view and to enlarge curves in several axis systems, select the band cursor or the frame cursor on the DIAdem VIEW toolbar. All the axis systems in a worksheet have the same band cursor or frame cursor and display the cursor in the same value ranges. The zoom you specify with the band cursor or the frame cursor applies for all axis systems. The narrower the band cursor, the more the section is enlarged. You enable and disable zooming and scrolling on the toolbar of the individual axis systems.

If you examine a section of a curve and you want to see the entire curve at the same time, you define two 2D axis systems with the same curve definition. One of the axis systems displays the entire curve and the other axis system zooms a section of the same curve. Click **Band Cursor** on the DIAdem VIEW toolbar, and click **Scroll in Cursor Range** on the toolbar of the second axis system. If you now move the band cursor in the overall axis system, the zoomed axis system displays the section of the curve that is inside the band cursor.

Analyzing Curves

Each axis system has a cursor, which you move along the curve manually with the mouse or with the arrow keys, or which you move automatically with the toolbar functions. Use the **Cursor Parameters** button to vary the speed of the cursor along the curves after you click **Play** on the toolbar.

If one axis system has several curves, the cursor moves along the leading curve. To specify the leading curve, click the checkbox in the legend that is the same color as the curve. If the individual curves have different x-values, DIAdem interpolates the x-values of the other curves according to the x-values of the leading curve. The cursor position on the leading curve also determines the display in the other areas of the worksheet if the displays use the same reference axis for cursor synchronization. If the worksheet contains several axis systems, the cursors move along the other axis systems. If you play a video of the test, DIAdem displays the video frame that matches the current measurement value. If you project the data onto a 3D model, DIAdem displays the projection at the time of the current cursor position. Select **Go To»Cursor Position** from the context menu of the channel table to find the current value in the channel table.

The standard cursor is a crosshair cursor which can either move freely, follow the curve, or jump to the minimum or maximum values of the curve. To examine the maximum values on a curve, select **Maximum Values Cursor** on the toolbar. If you move the cursor along the curve, the crosshair jumps from one maximum value to the next. DIAdem displays the x-values and the y-values of the data points on the status bar and in a tooltip that moves along with the crosshair cursor. To view the x-values and the y-values of the individual maximum values in the coordinates display, click **Coordinates** on the DIAdem VIEW toolbar.

In the 2D axis system you can use additional cursor lines at the cursor for the analysis. Select the **Harmonic Cursor** on the toolbar of a 2D axis system to measure intervals of the same width. The harmonic cursor displays several cursor lines to the right of the main cursor. Their distance to each other corresponds to the distance of the main cursor to the axis origin. The distances increase when the distance of the main cursor to the axis origin increases. Select the **Sideband Cursor** to inspect fixed intervals on the left and on the right side of the main cursor. The additional cursor lines are equidistant. The distance remains the same when the sideband cursor moves. Specify the number of cursor lines in **Settings»Cursor Parameters»Number**.

Editing Curves

You also can edit curves in the axis systems. For example, if a curve has erroneous sections or outliers, you can replace the erroneous curve points. The functions **Flags: Remove Data Points**, **Flags: Copy Data Points**, and **Flags: Interpolate NoValues** edit the curve points that you marked previously with flags.

Click the **Band Cursor** on the DIAdem VIEW toolbar to select a curve section. Set the band cursor to a width that encloses the vertical lines of the wanted curve section. In the axis system toolbar, click the **Set Flags** button to mark all the curve points in this section of the leading curve.

If you want to mark the curve points of all the curves in this curve section, <Shift>-click **Set Flags**. Use the crosshair cursor and click **Set Data Point and Flag** in the axis system toolbar to mark single points.

You delete selected curve points or curve sections with **Flags: Remove all Data Points** on the toolbar of the axis system. Select **Settings»DIAdem Settings»VIEW** to specify whether DIAdem deletes the curve points from the channels or replaces the curve points with NoValues.

To copy selected curve points or curve sections, click **Flags: Copy Data Points** on the toolbar of the axis system. DIAdem creates a new channel for each selected curve, in the default group of the Data Portal.

To replace sections that you delete and to replace them with NoValues, click **Flags: Interpolate NoValues** on the axis system toolbar. Select **Settings»DIAdem Settings»VIEW** to specify whether DIAdem applies linear interpolation or interpolates with a spline function.

You can also select several sections to delete, to copy, or to interpolate all the selected curve points. To remove flags from all curves, click **Remove Flags from All Data** on the DIAdem VIEW toolbar.

Selecting an Axis System

Use axis systems in DIAdem VIEW for an overall view of your data. 2D axis systems display data in the x/y plane and polar axis systems display data in a full circle. Bode axis systems display the phase and the amplitude on top of each other. The orbit and shaft centerline axis systems analyze rotating shafts.

2D Axis Systems

In 2D axis systems you can display curves as lines, spikes, and stairs and also define constants parallel to the x-axis and the y-axis. In 2D axis systems you can color background sections in order, for example, to display changed test conditions. To do so, double-click the axis system and select **Background Segments** in the dialog box. Select two channels from which DIAdem reads the state and the position of the segments and specify the background color and the direction of the segments parallel to the x-axis or the y-axis. If you specify several segments, specify the transparency of the color in such a way that all colors are visible if the segments overlap.

If you load acoustic data saved in waveform channels into a 2D axis system, DIAdem VIEW can play the acoustic data. For example, if you load the waveform channel `Noise_1`, DIAdem enables the loudspeaker symbol on the toolbar of the axis system. Click **Play** or **Repeat Play** to output the signal on the computer loudspeaker. If a 2D axis system contains several curves, use the colored curve symbol to specify which channel to play. DIAdem plays the waveform channel synchronous to the cursor. Specify the play speed with the **Cursor Parameters**. If you enable the minimum or the maximum cursor, there is no sound.

Polar Axis Systems

Use the **Polar** display type to display data over the angle as curves in a full circle. You need one or two channels in order to define a polar curve. In channel pairs, the x-channel contains the angle and the y-channel contains the amounts, and thus the distances from the axis origin. You can change the angle direction and also the position of the zero-point for the polar axis system.

Bode Axis System

Select the **Bode** display type to display the phase shift and the amplitude amplification of a complex transfer function as super-imposed curves. To define a curve, you must specify two or three channels. You can scale the y-axis of the amplitude display and the joint x-axis linearly or logarithmically.

Orbit and Shaft Centerline Axis Systems

Use the display types **Orbit** and **Shaft Centerline** to analyze rotating shafts. Select the **Orbit** display type to display the movement of a rotating shaft as concentric curves. Use the **Shaft Centerline** display type to display the deflection of the rotating shaft from its idle position as a curve. To define a curve, you must specify two channels. Both axis systems are quadratic and have the same scaled axes because the values of the two sensors on the rotating shaft always have the same unit. In the axis system DIAdem displays the rotation direction of the shaft and also the position of the two sensors. If you specify a maximum bearing clearance, DIAdem shows this limit as a curve or an ellipse in the axis systems.

Figure 3-3. Vibration Analysis in 2D-, Bode, and Shaft Centerline Axis Systems
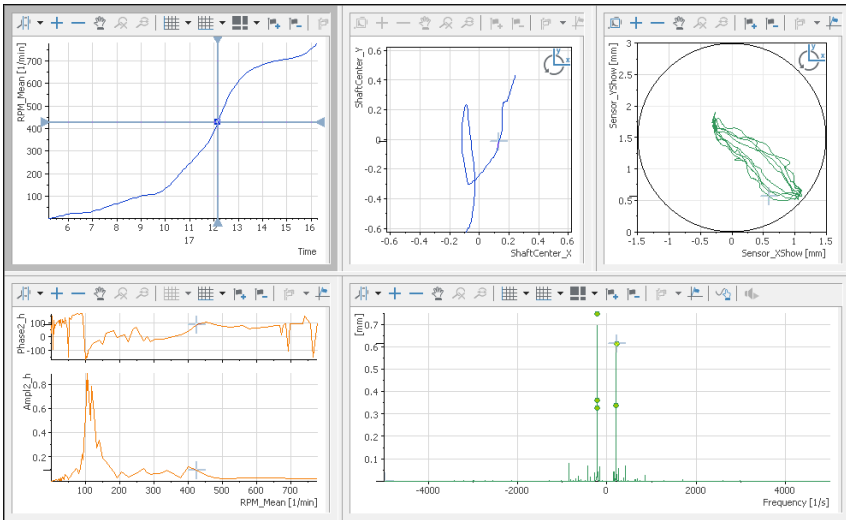
Synchronizing Curves with Videos and Maps

In DIAdem VIEW you can simultaneously contrast different measurement data as curves and also synchronize test data recorded on video and the recorded route of a test drive.

Evaluating Videos and Curves

Use the **Video** display type to evaluate data and videos which were recorded simultaneously. DIAdem opens the dialog box for the selection of a video file. DIAdem supports the video formats that have the filename extensions `.avi`, `.mpg`, `.mpeg`, and `.wmv`. If you want the video to ignore the page ratio and fill the complete area, disable the setting **Keep Aspect Ratio** in the context menu or when you load the video. To load a different video, select **Select Video** from the context menu.

To view a complete video, use the operating functions on the DIAdem VIEW toolbar. DIAdem does not enable the operating functions until you click a video area or a 2D axis system. To inspect specific points or a period of time more closely, use the curve cursor in the axis system. For example, if an unexpected event occurs in the test, move the curve cursor to the respective curve points. DIAdem VIEW shows the video and the curve synchronized over time. Use the plus and minus buttons or the mouse wheel to zoom in and out of the video view. If the video has an audio track, you can also play the sound. To do so, select **Sound On** from the context menu.

Synchronizing Videos and Data

DIAdem VIEW uses the time channel of the 2D axis system and the frame rate of the video to synchronize videos and curves. When DIAdem loads the video file, DIAdem reads the frame frequency and sets `0` as the start time. The start time specifies in seconds the time of the measurement value in the first video frame. In most cases, for example, if you record the video with a camcorder, you can apply these settings. Depending on the data acquisition rate, DIAdem displays the same video frame for several measured values. For example, if the data acquisition rate is 100 kHz and the frame rate is 1,000 frames per second (1 kHz), the video frame changes at every 100th data point on a curve.

To change the start time and the frame rate, double-click the video area and open the synchronization settings. If the time channel of the axis system returns an absolute time range with the date and time, and not the measurement time of the test in seconds, you must convert the start time into the internal DIAdem time format, which is the number of seconds that have elapsed since the year zero. To do this, use the `TTR` command in the Calculator. If you run the video or move the cursor in the axis system after you synchronize the video, DIAdem moves the cursor synchronously to the video.

If the video time range is not the same as the time range of the measurement data, you must specify the play range in which the measurement data overlaps with the video. To specify the beginning and the end of the play range, position the band cursor on the time range, during which the video was recorded, in the 2D axis system. Then click the **Cursor Parameters** button on the toolbar and clear the **Specify play range automatically** checkbox. Click **Apply** below the

cursor position to apply the positions of the band cursor for the beginning and the end of the play range. If you now use the operating functions, the cursor moves in the axis system and only plays the video within the play range.

Evaluating Maps and Curves

Use the **Map** display type to evaluate measurement data and geographical data simultaneously recorded with a GPS receiver of, for example, a test drive. If your computer is online, DIAdem loads the maps from OpenStreetMap. Right-click the map and select **Display** from the context menu. Connect the map display with the recorded longitudes and latitudes, and the time channel. During the evaluation, DIAdem moves the map so that the position marker is always visible in the map section. In addition, you can show the route as a track.

You cannot move the position marker in the map section directly with the mouse. You can move it only indirectly, for example, with the cursor in a 2D axis system. To synchronize the cursor, enter the same channels in the axis system that you entered in the map section under cursor synchronization. If the curve displays speed over time in the axis system, you synchronize over the time channel. If the curve in the axis system displays the driven route, you synchronize over the longitude or the latitude. You need only one channel for the synchronization of the curve cursor, the maximum value cursor, and the minimum value cursor. For the free cursor you need two channels.

You can enlarge, reduce, and move the displayed map section. To resize a map section, use the scale displayed in the map or use the mouse wheel. Double-click the map display to enlarge the map section around the clicked position, which DIAdem simultaneously positions in the middle of the map section.

If you want to use a map display when your computer is offline, select the setting **Save map data in cache**. DIAdem saves all map displays as graphics files on the computer. To display these files, select the map type **Cache** in the offline mode. You can also use this map type to speed up the map display because DIAdem can load the graphics directly from the computer.

3D Data Display

In DIAdem VIEW you can project data onto 3D models, display 3D data two-dimensionally with colored isolines in contour displays, or as a waterfall with 3D curves. For example, use the projection onto 3D models to display temperatures that occur on a component with color changes. Use the contour area to display and to analyze characteristic diagrams of the engine power over the rpm and the compression. Use a cascade display to, for example, display the vibration amplitude over the frequency as a waterfall.

Contour Display with Isolines

Use the **Contour** display type to display 3D data two-dimensionally by using the third dimension of the data as color values and isolines. Use the contour display, for example, to map data from engine test stands as characteristic diagrams and to analyze the data with the cursor.

To display a characteristic diagram, drag the channels `Revs`, `Torque`, and `Nitric oxide` from the Data Portal and drop them in a free area of the layout. Select the display type **Contour**. DIAdem displays the concentration of nitric oxide in relation to rpm and torque as a color shading. The color legend below the contour indicates that the blue color hues represent a low concentration and red color hues a high concentration. You can zoom in and out of a contour display, move it and view sections in more detail with the frame cursor. The contour display supports the triple structure used here and also the matrix structure of 3D data.

Refer to *Organizing 2D Data and 3D Data* in Chapter 2, *Finding and Managing Data* for more information about 3D data.

Click the **Display Dynamic Isoline** button on the toolbar of the contour display to analyze how the concentration of nitric oxides is distributed in the contour. If you move the cursor over the contour, DIAdem displays the isolines dynamically for the concentration at the current cursor position. To create an isoline permanently, click **Create Isoline at Cursor Position** on the toolbar of the contour. DIAdem calculates the isoline for the current z-value of the cursor, saves the result channels in the Data Portal default group, and then displays the respective isoline.

To highlight the concentration of the nitric oxide in the color shading, you can insert isolines into the contour. To do so, you create a contour table. Double-click the contour and click the curve type **Contour**. Select the curve parameters **Isolines from contour table»Display** and open the **Contour Table** tab. Click **Generate Isolines** and enter the start value, the end value, and the step width. To label the isolines with the concentration values, enable the curve parameter **Isolines from Contour Table»Label** on the **Surface** tab. The contour displays gray isolines with the concentration steps in the color shading.

Use **Create and Refresh Channels for Intersection Curves** on the toolbar of the contour to place a horizontal and vertical intersection through the contour. DIAdem calculates the intersections parallel to the x-axis and parallel to the y-axis for the current cursor position and saves the four result channels in a separate channel group in the Data Portal. You can display the calculated sections in 2D axis systems and synchronize them with the contour. If you move the cursor in the contour or in one of the two axis systems, the two other cursors move synchronously.

Figure 3-4. Contour of the Nitric Oxide in PPM over RPM and Torque
with Vertical and Horizontal Intersection Curve
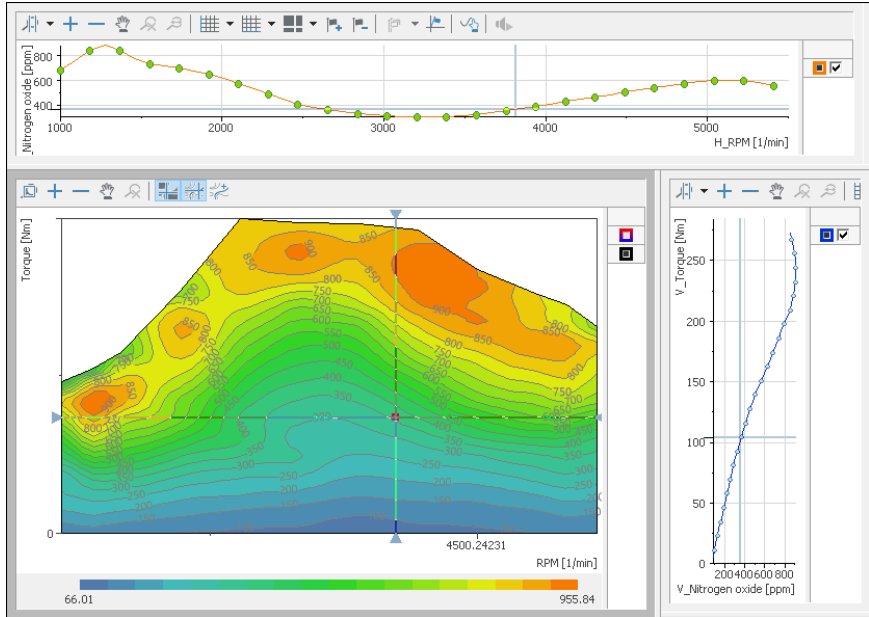
Cascade with Order Lines

Use the **Cascade** display type to display 3D data as a waterfall. DIAdem displays amplitudes as consecutive curves and can also show order lines in order to highlight rotation speed-dependent vibrations in the cascade.

You create order lines based on a channel. Double-click the cascade to select an order channel. Afterwards, you create the order lines directly in the dialog box or use the functions on the toolbar of the cascade display. Click **Additional Order Lines** in the dialog box and create one or more static order lines by defining the orders. Click **Display dynamic order lines** on the cascade display toolbar to show the order lines at the current cursor position. If you click **Generate order line at cursor line**, a static order line displays in the cascade. DIAdem calculates the order line for the current z-value of the cursor, saves the result channels in the Data Portal default group, and enters the new order line into the curve list of the cascade.

Use **Generate and refresh dynamic orderlines** to show the order line curve in a dynamic display in a 2D axis system. DIAdem stores the x-channel and the y-channel of the order line in the Data Portal. Use these channels to define the curve in the 2D axis system. If you move the cursor over the cascade, DIAdem displays the current order line in the cascade. At the same time, DIAdem recalculates the values of the two channels and displays the refreshed order line curve in the 2D axis system.

Figure 3-5. Vibration Progress and Amplitudes over the Frequency and over the Order
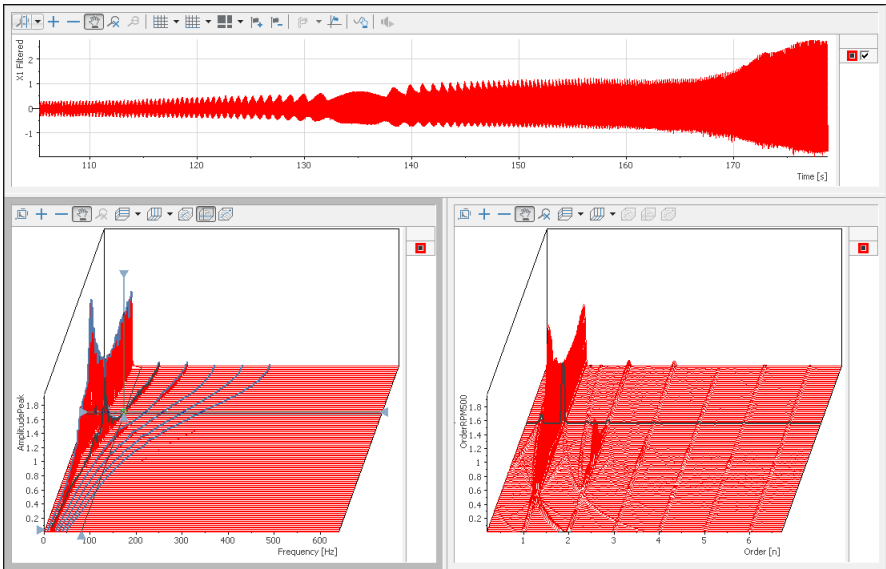
Projecting Data onto 3D Models

Use the **3D Model** display type to project measured data or data created with a simulation, as color shading or as deformation onto a model of the test object. For example, 3D models display the temperatures in a car as color shading on a temperature dummy or display strain as deformation of a bridge support. You connect the data of each sensor to the associated model point on the basis of the three-dimensional model of the test object. For model points with no sensor, DIAdem interpolates the values from the data of neighboring model points. You also can define several model windows with the same model in one view, to compare different perspectives or test results.

For example, to inspect the temperature profile on a beam, select the display type **3D Model** from the area context menu. DIAdem VIEW opens the dialog box for the selection of a 3D model. Load the model `beam.wrl`. Drag the `Temperature1` channel from the Data Portal to a model point. Select the display type **Coloring**. Repeat this process for other model points.

If you want to display deformations of the model surface, use the display mode **Deformation**. Select on which coordinate axis DIAdem moves the model point.

Use the operating functions on the DIAdem VIEW toolbar to gain an overall view of the complete test. If you want to inspect time sections in more detail, create a 2D axis system with the temperature channels and use the curve cursor in this axis system. For example, if extreme temperatures occur in the test, move the curve cursor to the respective period of time. DIAdem displays the temperatures on the beam in color. The red colors indicate warm areas and the blue colors indicate cool areas.

If you assign a data channel to the incorrect model point, press <Shift> and drag and drop the definition to the correct model point. Press <Ctrl-Shift> to copy a definition. The tooltip for a point shows which display type and which data channel you used to define the point.

You can move and zoom the model to view it from all sides. To rotate a model, click and drag the mouse. To zoom a model in or out, move the mouse wheel or right-click and drag horizontally. To move the model along a coordinate axis, right-click, move the mouse up and down, and press <x>, <y>, or <z> at the same time to choose the coordinate axis you want.

DIAdem supports VRML models with the filename extensions `.wrl` and `.stl` (Surface Tesselation Language), which can export CAD/CAE programs.

Editing the Display

You can combine different display types for one model point in the model settings. For example, you can display temperature simultaneously as color shading and as deformation. Double-click the model to open the settings. Select the **Sensor List** tab to enable the coloring or the deformation of the x-axis, the y-axis, and the z-axis for each model point. You can delete or copy existing definitions and create new definitions.

Select the **Display** tab to modify the display of the base model and also the settings for the surface coloring and the deformation. Use points, grids, and grid surfaces to specify the display of the base model. Select the checkboxes **Points»Channel values** to show the current numeric value at each defined sensor point. Specify the value range to which DIAdem applies the color shading. By default DIAdem uses the highest and the lowest value of all assigned channels for scaling. You also can scale the model manually, for example, to limit the coloring to the main range, which eliminates outliers. You can also specify the color palette under user-defined coloring.

If you enable deformation, DIAdem shows an offset copy of the model. During an evaluation you can compare this deformation model directly with the unchanged base model. The offset specifies the distance between the two models. If you only want to view the deformation model, disable the settings for the base model. If you also want to show the coloring of, for example, the temperature channels you defined in the sensor list, on the deformation model, select the **Color surfaces** checkbox for the deformation model. To display even slight deformations, you can use the scaling factor to enlarge the deformation.

Interactively Evaluating with Dialog Boxes

Use the **Dialog Box** display type to influence the displays in the other areas of the layout during an evaluation by entering values, requesting settings, or executing functions. Scripts process the entries, transfer the values to the other areas in the worksheet, and refresh the display in DIAdem VIEW.

You can include every user dialog box which you created in the dialog editor of DIAdem and to which you added the invisible control VIEWConnector. Select the display type **Dialog Box** to include a dialog box in an area. Load a dialog box file with the filename extension .sud and enter the name of the dialog box because one SUD file can contain several dialog boxes. DIAdem fills the entire area with the dialog box. To edit the dialog box, select **Edit Dialog Box** from the context menu. DIAdem opens the dialog editor with this SUD file. Enter properties and events, which influence other controls or call scripts, for every control. For example, you can create scripts to move curve points in axis systems or to create new curves. After saving dialog box changes, open DIAdem VIEW and select **Reload Dialog Box** from the context menu to refresh the display.

Use the Flex property so that a dialog box dynamically adapts to the current size of the area. You can assign different flex properties to the individual controls so that the position of the controls change respectively when the area or the DIAdem window is scaled.

Using Text and Graphics for Design

Select the **Textbox** display type to add headings or comments to a worksheet. After double-clicking the textbox, you can enter text and variable information, for example, the current date with @@CurrDate@@. You can also select a property, such as the name of the data set, in the Property Display of the Data Portal, and drag and drop the property to the textbox. Use the context menu to refresh the variable contents at any time. Select **Display** from the context menu to modify the text display and use the button with the three dots at the end of the input field to insert variables and expressions. Refer to the section on *Variable Formatting* in Chapter 5, *Creating Reports*, for more information about variables.

Use the **Graphic** display type to include a diagram of a test stand or to insert a company logo into your worksheet. Double-click the image area to load a new image. DIAdem supports the current image formats.

When you insert graphics, DIAdem generates a link to the graphics file. DIAdem saves the link with the path in the layout. When you load a layout, DIAdem only can display the image if the image file is in this folder. To use a layout on different computers, use DIAdem path variables, such as @@LayoutReadPath@@ImageFile.jpg.

4

Analyzing Data with Mathematical Functions

You can use DIAdem ANALYSIS to analyze data from the Data Portal with mathematical functions. The dialog boxes for the standard mathematical functions guide you through the calculation so that you do not have to enter a formula. You select the input data and the settings. Use the DIAdem Calculator to define and calculate your own formulas. For complex, recurring calculations, you can write scripts. In the calculation manager you define complex analysis sequences which can be standard functions, user-defined formulas, and calculation scripts. Save the calculation results in channels or in variables.

Figure 4-1. DIAdem ANALYSIS
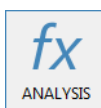
Using Standard Functions

DIAdem ANALYSIS has extensive libraries with standard mathematical functions in several function groups. For example, the basic mathematical function group contains the differentiation function, the signal analysis function group contains the FFT function, or the 3D analysis function group contains contour line calculation.

To use a standard function, click the associated button. You select the calculation settings in the dialog box that opens. The preview shows the result curve with the settings in contrast to the curve with the unchanged input data. For example, if you want to smooth data, select the **Curve Fitting** function group and click the **Smooth** function. Drag and drop the **Channel** that you want to smooth from the Data Portal into the channel selection field in the dialog box. Specify **Max. smoothing width on one side (no. of points)** and the smoothing procedure. If you have already used the smoothing function in your current work session, the last calculation settings appear in the dialog box. Click **Calculate** if you want to execute more smoothing functions. Click **OK** to execute the calculation and to close the dialog box.

Figure 4-2. Curve Fitting Function Group
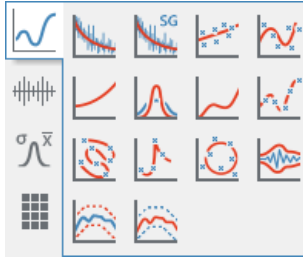
DIAdem stores the calculation result in new channels of the default group. You specify the default group in the context menu of the Data Portal structure view. If you select **Store result in original channel** in the dialog box of a standard function, DIAdem overwrites the values of the input channels with the result data. Do not select this setting if you want to use the input channels again. Some standard functions, such as descriptive statistics or approximation store the calculated characteristic values as custom properties in the result or input channels.

If you call another standard function, DIAdem prompts you to apply the function to the result channels of the last calculation. You can use all the numeric channels, waveform channels, and time channels in the Data Portal to execute calculations. The DIAdem ANALYSIS workspace shows you which calculations you have run with which channels. Click **Export ANALYSIS Log** on the toolbar to save the work log.

If a standard function, for example, the average channels function processes several channels, the channel selection field has a button with three dots. Click this button and select all input channels in the channel selection dialog box or select the input channels in the Data Portal and drag and drop these channels into the channel selection field. If the channels are different lengths, the result channel is the same length as the shortest input channel.

If you execute calculations with waveform channels, you do not need to specify an x-channel, because the waveform channel contains the x-part. If a standard function uses several channels, only one channel must be a waveform channel for DIAdem to create waveform channels as the result. If you do specify an x-channel, the results of the calculation are numeric channels. If you use several waveform input channels, the x-parts of the waveform channels must correspond.

Which functions libraries you can use depends on which options your DIAdem license has. Functions not included or enabled in your license are dimmed on the DIAdem interface. You can obtain additional function libraries from NI. For further information on the available function libraries, refer to *Function Libraries* in this chapter.

Calculating Formulas in the Calculator

Use the Calculator to calculate data with your own formulas. In formulas you can combine numeric channels, waveform channels, and time channels and generate new channels. You use the text operations for calculating with text channels. You can calculate single values, save values in variables, and request variable contents.

Open the **Calculator** on the toolbar in DIAdem ANALYSIS. The Calculator can stay open while you execute other calculations in DIAdem. You can hide the configurable function keys and only use the basic functions.

Entering Formulas

Use the keyboard and the Calculator keys to enter a formula in the **Formula** field. The result field displays the formula expression of your entry. If there is an error such as a missing closing parenthesis in your entry, DIAdem identifies this with a red frame in the formula expression. If the formula entry is correct, click **Calculate**. The Calculator displays the calculation result.

A formula consists of the assignment target, the assignment operator, and the calculation statement:

```
Assignment target = Calculation statement
```

You usually enter a channel as the assignment target. However, you can also calculate a single value and assign the single value to a variable. In the calculation statement you use operations on channels or variables. The standard functions contain operations such as exponential or comparison operations and the extended functions contain operations such as sine function or the maximum value of two numbers.

For example, click the **sin** button in the extended mode, to calculate the sine values of a channel. The cursor in the **Formula** field is automatically positioned in the argument section of the sine function, so that you can drag and drop a channel from the Data Portal correctly into the formula.

In the Calculator, always use a decimal point as the decimal separator and enclose strings in quotation marks ("...").

Calculating with Channels

For example, to divide the Input channel by the Reference channel from the first channel group, enter the following formula in the Calculator **Formula** field:

```
Ch("[1]/Result") = Ch("[1]/Input")/Ch("[1]/Reference")
```

DIAdem divides each value of the Input channel by the corresponding value of the Reference channel. If the channels are different lengths, the result channel is the same length as the shorter channel.

DIAdem stores the result in the `Result` channel in the first channel group. If the `Result` channel already exists in the first channel group, DIAdem overwrites the values. If you enter only the channel name without the group index, DIAdem stores the result channel in the default group of the Data Portal.

In order to calculate with channels in the Calculator, the channels must have a unique reference. If you drag and drop channels from the Data Portal into the Calculator, DIAdem uses the `Ch` variable and sets the channel name in quotation marks. DIAdem uses the group index and the channel name to create a unique channel reference. However, a channel reference can also consist of the group name or the group index combined with the channel name or the channel index. The group index is the position of the group in the Data Portal and the channel index is the position of the channel in the group.

If you know the names of the channel groups and of the channels of the data set, and if the name of the first group is `Group1`, enter the following formula:

```
Ch("Group1/Result") = Ch("Group1/Input")/Ch("Group1/Reference")
```

If you know the structure of a data set, you can combine the group index and the channel index. Then enter the formula as follows:

```
Ch("[1]/[5]") = Ch("[1]/[1]")/Ch("[1]/[2]")
```

Note   You can also use only the channel name for the channel reference. This channel reference is ambiguous if several channels in different groups of the Data Portal have the same name. DIAdem calculates with the first channel it finds with the specified name in the Data Portal.

Calculating with Variables and Single Values

In the Calculator, you can store values in variables, use variables in calculation statements, and request variable values. The following examples show how you enter these three alternatives, for example, for the auxiliary variable `R1` in the **Formula** field:

You assign the result of the square root of `8.391` to the variable `R1`:

```
R1 = sqrt(8.391)
```

Use the variable name to request the value of a variable. The Calculator displays the value in the result box:

```
R1
```

You multiply each value of the `Input` channel from the first channel group by the `R1` variable. DIAdem stores the result values in the `Result` channel of the default group:

```
Ch("Result") = Ch("[1]/Input")*R1
```

Assigning Buttons and Exporting Formulas

In the Calculator you can assign the buttons in the extended mode with the functions you need regularly for your formula calculations. Click **Configure Function Buttons** in the Calculator to view all configurable function buttons. In this dialog box, you select an operation, edit the button label, and describe the function in a tooltip. The Calculator functions are described in the *DIAdem Help*.

Use the Calculator to test formula expressions for the Calculation Manager and for scripts. In the preview you can check whether the syntax of the formula expression is correct. The success or failure of the calculation also shows whether the channel references, for example, are correct. If your formula is correct and returns the right result, you can export the formula. Click **Formula Transfer to Calculation Manager** to open the Calculation Manager, which will contain your formula as a new calculation. Click **Prepare for SCRIPT and Copy to Clipboard** to insert the formula as a code line in a script.

Calculating in Scripts

Use scripts to automate complex, recurring calculations. In scripts, you can call standard functions or create your own formulas. A script is a VBS file that DIAdem processes line by line. To enter the following examples, create a new script in DIAdem SCRIPT and enter the sample lines. Refer to *Calculating Formulas* in Chapter 6, *Automating Sequences*, for more information on scripts.

Calling Standard Functions

In scripts, you can use all the standard mathematical functions available in DIAdem. Use the `Call` command to call standard functions. For example, to smooth the numeric channel `Input` with a smoothing width of 12, and to store the result in the `Result` channel in the first channel group, enter the following line in a script:

```
Call ChnSmooth("[1]/Input","[1]/Result",12,"maxNumber")
```

Calculating Your Own Formulas

In scripts, you can also calculate your own formulas. For example, to divide the `Input1` channel by the `Reference` channel from the first channel group, enter the following statement in a line of the script:

```
Call Calculate("Ch(""[1]/Result"") =_
Ch(""[1]/Input"")/Ch(""[1]/Reference"")")
```

Use `Call` to call the Calculator function `Calculate`. The formula is in single quotation marks and the individual channel assignments are in double quotation marks. The formula has the same syntax as in the Calculator.

Assigning Single Values

In scripts, you can assign values to variables like in the Calculator. For example, to assign the square root of 8.931 to the auxiliary variable R1, enter the following line in a script:

```
Call Calculate("R1=sqrt(8.931)")
```

Using Variables

DIAdem offers program variables, auxiliary variables, and user variables. You can use VBS variables as well as DIAdem variables. Refer to the section on *Using Variables* in Chapter 6, *Automating Sequences*, for more information about variables.

Use program variables to configure the command of a standard function in a script. You set the parameters in the same way as you make settings in the dialog box for the standard function. The SmoothWidth program variable specifies the smoothing width for the ChnSmooth command of the standard function **Smooth**.

Use VBS variables in scripts if you need variables that are not linked to a command. Unlike DIAdem, VBS does not provide predefined variables or data types. VBS variables are always a variant data type, which uses different data types depending on what you use the variable for. A VBS variable reacts like a number when you use the variable in a calculation and like a string when you assign text to the variable.

Declare VBS variables with the Dim statement. The following example shows the declaration for the array variable MyArray, for the text variable MyChannels, and for the count variable iCount. This example generates a matrix with the 100 x-values and the y-values of the sine function and converts the matrix into channels:

```
Dim MyArray(1,99), MyChannels(1), iCount
For iCount = 0 to 99
  MyArray(0,iCount) = 2*Pi*iCount/99
  MyArray(1,iCount) = Sin(2*Pi*iCount/99)
Next
MyChannels(0) = "X Channel"
MyChannels(1) = "Sine Channel"
Call ArrayToChannels(MyArray,MyChannels)
```

Quantity-Based Calculations

Since the introduction of the units catalog, you can choose whether DIAdem includes the physical quantities and units of the channels in a calculation or not. In non-quantity based calculations, DIAdem uses only numeric values in the calculation, so that you can add a length and an electric voltage. When executing quantity-based calculations, DIAdem checks whether the selected physical quantities can be processed together. For example, you can divide a time by a length but you cannot add these quantities. If DIAdem cannot calculate the physical quantities with each other, DIAdem aborts the calculation with an error message.

If two units to be calculated with each other belong to the same physical quantity, for example, centimeter and inch, DIAdem converts the units to the joint base unit. For example, if you add 1 cm (centimeter) and 1 in (inch), the result is 1.39 in. If you do not execute the calculation quantity-based, the result is the numeric value 2.

Click **Calculate Quantity-Based** on the DIAdem ANALYSIS toolbar or assign in scripts the value TRUE to the CalcQuantityBased variable to calculate quantity-based with the units catalog.

To calculate quantity-based in DIAdem, all input data must have units and unit symbols defined in the units catalog. In operations, such as addition, subtraction, or average, DIAdem does not change the physical quantities but transfers these to the result data. These functions cannot calculate different physical quantities with each other, such as length and electrical voltage. In operations such as multiplication, differentiation, integration, exponential functions, or root functions, DIAdem determines the result quantity from the physical input quantity. For example, if you multiply a force by a length, the result quantity is energy.

When calculating a quantity, DIAdem follows certain rules. The dimension of the result quantity must have integer exponents. For example, you can extract the square root of a surface and gain a length. However, you cannot calculate the square root of a volume, because this calculation results in a non-integer exponent in the dimension. DIAdem specifies the unit of a physical quantity in such a way that a minimum of conversions is required. If the units used are non-linear or have an offset, DIAdem always converts these units into a linear unit. For example, the units °C (degrees Celsius) and °F (degrees Fahrenheit) have an offset. Therefore, DIAdem uses the base unit K (Kelvin) when these temperatures are included in a calculation. Refer to *Using the Units Catalog* in Chapter 2, *Finding and Managing Data*, for further information about the units catalog.

Calculating with the Calculation Manager

In the calculation manager, you define calculations to execute recurring analysis sequences with a mouse click. A calculation can contain simple formulas, standard functions, or scripts. An analysis sequence can connect calculations if a calculation step accesses the result of a different calculation step.

Open the **Calculation Manager** on the DIAdem ANALYSIS toolbar. Click **Add Calculation** to create a new calculation, or click the button with the three dots to edit an existing calculation.

A calculation connects inputs and saves the result in outputs. Inputs and outputs might be single values and variables, or one or several channels. The inputs and outputs are connected in the Calculation through their names, which might be just letters. The following formula squares and adds the inputs a and b and transfers the square root to the output c:

```
c=sqrt(a^2+b^2)
```

You use standard functions the same way as you do in a script. Click **Extended** to switch to the script input. Call a command with Call and use the names of the inputs and outputs as

parameters. The following instruction calculates the smoothing function for input `a` and returns the results to output `c`:

```
Call ChnSmooth(a,c,15,"MaxNumber")
```

If you calculate functions, such as averaging over more than one channel, use a channel list. A channel list contains the names or indexes of the input channels. In the Data Portal, you can select individual input channels as well as several input channels that are one below the other, which DIAdem enters into the channel list.

You can execute a calculation multiple times. If you want to analyze a test series of engine cylinders, you do not have to define a calculation for each cylinder but just one calculation with variable inputs and outputs. In an input you write `Cylinder_@@CCR@@` and enter the number of cycles. DIAdem replaces the expression `@@CCR@@` with the current cycle number every time a cycle executes. DIAdem evaluates the channels `Cylinder_1`, `Cylinder_2`, and `Cylinder_3` in three cycles.

Before you use a calculation, click **Validate** to check whether the definition is correct. DIAdem checks the syntax of the calculation instruction and the connection with other calculations if you set these as the input or output. In the validation script, you can specify further conditions for the execution of the calculation. Click **OK** to return to the calculation manager dialog box. Create calculation groups to group dependent calculations or to sort calculations according to their tasks.

You can save selected calculation groups or calculations, or all calculations defined in the Calculation manager in a calculation set with the filename extension `.tca`. If you want to make a formula collection available to other users without revealing any know-how, save the calculations encrypted. Other users can only execute encrypted calculation templates but not view or change them.

Select **Settings»DIAdem Settings»ANALYSIS** in DIAdem ANALYSIS to specify the calculation set that DIAdem loads when the program launches.

Calculating with Invalid Values

Measurement devices have a valid range for the measured values, for example, from 0 to 10 volts. During measurements, disturbances sometimes occur in the sensors, causing incorrect values. In DIAdem you can declare these outliers as invalid values. In DIAdem, invalid values are called *NoValues*. To identify a value manually as a NoValue, overwrite the value in the channel table of DIAdem VIEW with `NoValue` or with `NV` for short. Standard functions exclude NoValues from calculations and a report does not display NoValues. The following figure shows the measurement signal on the left and the result of a classification of the measurement signal on the right. The top diagrams contain the distortion, whereas the bottom diagrams have been adjusted with NoValues.

Figure 4-3. Left the Measurement Signal, and Right the Result of the Classification, Top with Distortion and Bottom Adjusted with NoValues
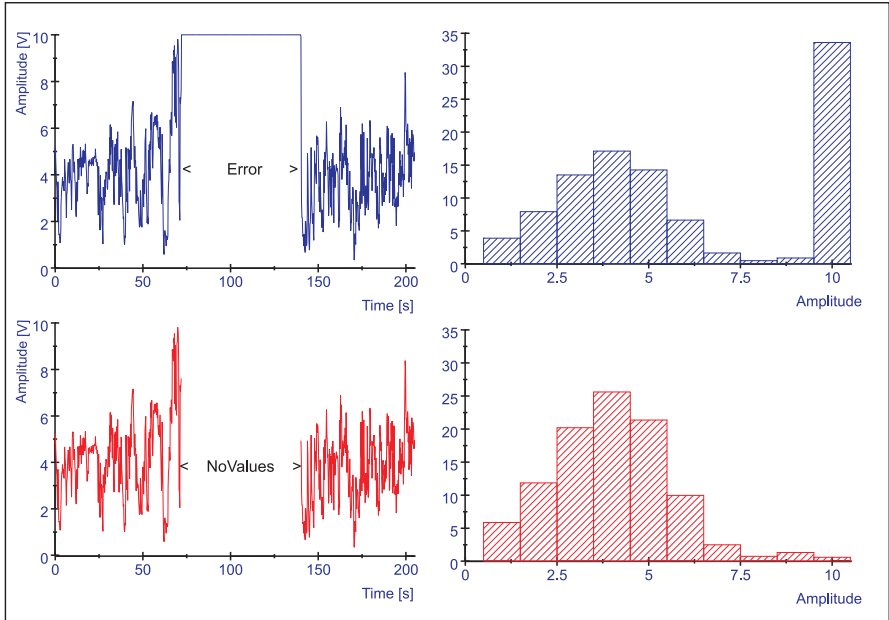
You can use NoValues to eliminate entire ranges, not just single values, from a numeric channel, a waveform channel, or a time channel. If you know that a sensor does not return values greater than 10, enter the following formula into the **Formula** field of the Calculator in order to replace incorrect values with NoValues:

```
Ch("Group1/Sensor") = Ch("Group1/Sensor")+ _
CTNV(Ch("Group1/Sensor")>10)
```

The Boolean request `Ch("Group1/Sensor")>10` checks whether a channel value exceeds the specified limit value `10`. If a channel value exceeds the limit, the result is `True`, otherwise the result is `False`. The `CTNV` function checks the results and returns `NoValue` for `True`, otherwise it returns `0`. The result of the addition with a channel is either the original channel value or `NoValue`. This replaces all values greater than 10 with NoValues.

Note If you calculate with NoValues, a calculation operation results in NoValue when one of the terms has the value `NoValue`.

Tip You can use the **Process NoValues** function in the **Channel Functions** function group to delete NoValues in channels, to replace NoValues by a value, or to replace NoValues through linear interpolation of the neighboring values.

Function Libraries

DIAdem includes an extensive library of standard mathematical functions for analyzing data. These functions are arranged by category in the DIAdem ANALYSIS function groups:

- Basic Mathematical Functions
- Channel Calculation Functions
- Curve Fitting Functions
- Signal Analysis Functions
- Statistics and Classification Functions
- 3D Analysis Functions
- Crash Analysis Functions

Basic Mathematical Functions

The **Basic Mathematics** function group contains the functions **Add**, **Subtract**, **Multiply**, and **Divide**, for calculating two or more channels rowwise. If the channels are different lengths, the result channel is the same length as the shortest channel. Use the **Rounding** function to reduce the number of decimal places of the channel values. Use the **Remove Duplicates** function to reduce the sections with successive identical channel values to the first value. The **Scale** function uses the linear equation ax+b to convert channels. If you need the reciprocal of each channel value, use the **Calculate Reciprocal** function. Use the **Offset Correction** function to subtract a constant from the channel values or to add a constant to the channel values.

Use the **Normalize** function to normalize a channel to the value 1. To do this, DIAdem divides each channel value by the highest absolute value in the channel. The **Relativize** function calculates for each channel value the percentage of the total sum of all channel values. The **Calculate Differences** function calculates the distances between the values of a channel so that the result channel is one value shorter than the input channel. You use the **Summation** function to calculate the consecutive sum of the single values of a channel.

The **Differentiate** function calculates the difference quotient from two successive value pairs of two channels. Use the **Integrate** function to integrate a channel on the basis of the trapezoidal rule or the Simpson rule. The **Calculate RMS** function calculates the root mean square.

Channel Calculation Functions

The **Channel Functions** function group contains the function **Generate Numeric Channel**, which generates new equidistant or geometric channels, or new channels from the x-part of a waveform channel. You can use this function to partition existing channels more finely. DIAdem partitions the intervals of successive values into equidistant intervals. The **Generate Time Channel** function calculates an equidistant time channel.

Use the **Numeric Channels <-> Waveform Channels** function to convert numeric channels and waveform channels. If you convert numeric channels to waveform channels, you must specify an equidistant x-channel. If you convert waveform channels into numeric channels,

DIAdem creates an x-channel and a y-channel from every waveform channel. If waveform channels are located consecutively in a group in the Data Portal, and if they have the same x-part, DIAdem creates one common x-channel for these channels.

Use the function **Numeric Channels <-> Assignment Channels** to create or to delete assignments in channels. Assignments are texts which are assigned to a value range of a channel, for example, `Valve open` for the value range `5...10 [bar]`. Click the button with the three dots to open the **Assignments** property of an assignment channel in order to edit and to extend the assignments.

The **Convert Channel Unit** function converts a channel into a different unit of the same quantity, for example, kilometers per hour `[km/h]` into miles per hour `[mi/h]`. The **Convert to Unit Set** function assigns a different unit set to multiple channels and converts the channels to the units of the new unit set. If you load a European unit set, DIAdem only needs a unit set with American units to convert the lengths, the surfaces, and the velocities of a data set into American units.

The **Average Channels** function calculates rowwise the arithmetic mean of two or more channels. The **Sort Channel Values** function sorts the values of a channel in ascending order. You can also specify other channels, such as text channels, to move the values of these associated channels accordingly. DIAdem offers two functions to determine the peaks in a channel. Use the **Find Peaks** function to find channel peaks which match the channel values. Use the **Calculate Peaks** function to calculate, for example, peaks for a noisy signal by interpolating the channel values. Both functions provide two result channels. One result channel contains the x-values and one the y-values of the peaks.

There are two functions for the event search. Use the **Event Search** function to check channels for window, slope, or comparison conditions. You can connect several conditions with AND and OR, and negate the condition with NOT. Use the **Event Search (Free Formula)** function with a free formula, and check channels for specific events. You can use comparison operators such as $<$ and $>$, and Boolean operations such as AND and OR in formulas. DIAdem stores the search result in a two-dimensional array variable.

The **Process NoValues** function deletes NoValues in channels or replaces NoValues with a given value or with a linear interpolation of the neighboring values. NoValues are invalid values which DIAdem does not use for calculations and does not display in a report. Use NoValues to eliminate corrupt measurement values from channels. Refer to *Calculating with Invalid Values* in this chapter for further information about NoValues.

The **Optimize Data Type** function rounds the channel values to reduce the necessary storage space when saving the data. DIAdem saves the relative rounding error and the storage saving in the custom properties of the result channels. Use the **Quantize** function to divide the value range of channels into intervals of equal width in order to map the channel values on these intervals by rounding. Usually the number of steps corresponds with the integer data types 8-bit, 16-bit, or 32-bit.

Use the **Phase Unwrap / Wrap** function for displays in the Bode diagram in order to handle jumps in the phase. You can create or delete phases within a value range of $-\pi$ ... $+\pi$ or of $-180°$ ... $+180°$.

Use the following functions to create a joint time base for signals of different measurements. The **Resampling** function specifies the new x-value range through an interpolation channel or a sampling rate. Use the **Synchronize Data from Different Files** function to resample or to delete an offset. The **Linear Mapping** function maps a signal onto a different x-channel through interpolation and extrapolation.

Curve Fitting Functions

The **Curve Fitting** function group contains the **Smooth** function for smoothing a signal. To smooth a signal, DIAdem calculates the floating arithmetic mean or median for each value from the channel value and from a specified number of neighboring values. The **Savitzky-Golay Filter** smoothes a signal by adjusting a polynomial function sectionwise to the signal with the least squares method. This method retains the characteristics of the signal better than the **Smooth** function.

Use the functions **Regression** and **Approximation** to calculate a curve with the closest resemblance to the original set of points according to specific criteria. The preview in the dialog box displays for each setup function how well the result approximates the channel values. For the result curve, you can specify a channel with evaluation points or you can generate the evaluation points. DIAdem saves the calculated coefficients in program variables and as custom properties in the result channels.

Use **Non-Linear Curve Fitting** to fit a set of points with a function. DIAdem uses the Levenberg-Marquardt algorithm to calculate the coefficients. Use the **Gaussian Curve Fitting** function to fit a set of points with a Gaussian curve. DIAdem uses the least square method, the least absolute residual method, or the bisquare method to calculate the center, the amplitude, and the standard deviation of the Gaussian curve. Use **General LS Linear Fitting** to calculate a k-dimensional curve by minimizing the error squares. DIAdem offers various methods, such as SVD, Givens, Cholesky, or Householder to solve the over-determined system of equations.

DIAdem uses **Non-Parametrical Splines**, **Parametrical Splines**, or **Akima Subsplines** for spline calculations. Use non-parametrical splines for function type curves that have strictly monotonic interpolation points. Use parametrical splines for not strictly monotonic interpolation points, for example, for closed curves. An Akima subspline calculation results in not continuously differentiable curves, which are especially suited for stair functions. You can use splines to interpolate or to approximate interpolation points.

Use the **Calculate Circle Approximation** function to calculate the regression circle, the incircle, and the circumcircle of a set of points in a Cartesian coordinates system. The maximum incircle, also called the fitting-in circle, is the largest circle within the set of points that does not contain a measured point. The minimum circumcircle, which is also called the envelope circle, is the smallest outer circle around the set of points that contains all the measured points. The centers of these extreme ideal circles do not have to be the same. They are independent of the

center of the regression circle. However, the concentric incircle and circumcircle have the same center and constitute an annulus with the least possible width that still contains all measurement points.

The **Calculate Envelope Curves** function specifies the upper and lower envelope of a set of points. The minimum and maximum values in the specified intervals determine the points of the envelope. The **Calculate Corridor** function calculates the tolerance band with a specified distance to the original curve and the **Check Corridor** function checks whether a curve is within a corridor.

Signal Analysis Functions

The **Signal Analysis** function group contains functions such as the fast Fourier transform, digital filters, frequency-weighted acceleration, shock response spectrum, and order analysis with which you examine the frequency parts of oscillations.

Fast Fourier Transform (FFT)

Use FFT to transfer signals from the time domain to the frequency domain and back. For example, each button you press on a telephone makes a different sound, each of which consists of two sine oscillations. The exchange receives this sound and can detect which number you dialed. In the time domain, the sound you create when you press the number nine is difficult to distinguish from the number five. The exchange runs an FFT on the received sound, because the sounds can be clearly distinguished in the frequency domain.

In DIAdem you can calculate the **FFT with One Time Signal**, the **Inverse FFT** for retransformation from the frequency domain into the time domain, and the **FFT with Two Time Signals** for the cross spectra and the transfer function. DIAdem calculates an FFT for the entire length of the specified channels, even if the channel length is not a power of two. The **Full Spectrum FFT** function executes various separate FFT analyses for the channels of the two vibration sensors, and a rotating shaft then connects the spectra to a complex FFT.

Use the **Third/Octave Analysis** as part of a **FFT (One Time Signal)** to examine the volume in frequency intervals, not the exact frequency distribution in the signal. The third/octave analysis sums up the amplitude values in the FFT for a time signal in standardized logarithmic frequency intervals, similar to the following figure.

Figure 4-4. Third/Octave Analysis of a Signal
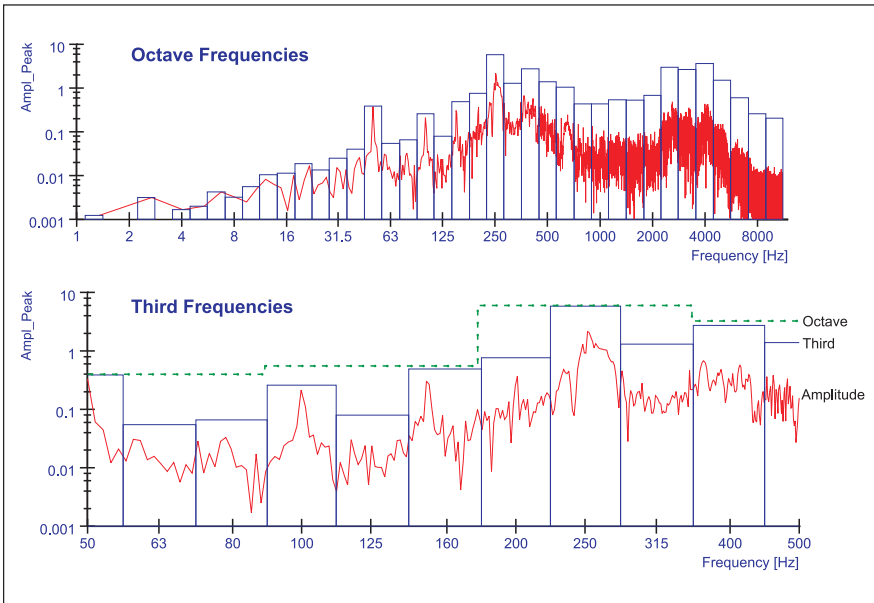
Correlations and Shock Response Spectrum

The **Auto Correlation** moves a signal copy on the time axis to monitor whether a signal has periodic parts. The **Cross Correlation** uses the same method to check two different signals for similarities. The **Shock Response Spectrum (SRS)** function describes the reaction of a system to a shock by calculating the acceleration from an acceleration signal over time, the relative velocity, or the relative displacement of the system over the frequency. The function includes the damping degree of the component. For example, if you let a cell phone fall to the ground, the degree of destruction is different for different cell phones. Use the shock response spectrum to evaluate the damage to the cell phones.

Vibration Characteristics and SINAD Analysis

The **Characterize Oscillation** function specifies the single frequency of the greatest amplitude in the complete or in the limited frequency domain of the signal. The function displays the frequency, the amplitude, and the associated phase as the result.

The **SINAD Analysis** (Signal to Noise and Distortion) function calculates the ratio of the total signal power to the distortion signal power and returns a measurement for the transmission quality of a signal. The total signal power at the receiver input results from the wanted signal, noise, and distortion. The higher the value, the better the transmission quality is. The SINAD analysis is used, for example, in radio systems (AM and FM).

Digital Filters and Frequency Weightings

With the **Digital Filter** function, you can attenuate or amplify selected frequency ranges of a time-dependent signal. You can choose from various filter types, such as lowpass, bandpass, and bandstop, which transfer only certain frequency ranges of the signal. The allpass filter, which lets through all the frequencies, is for signal delay and correcting phase distortion. You can use the various filters as IIR filters and FIR filters.

If, for example, a high-frequency distortion signal interferes with the actual measurement signal, you can filter out the distortion. To do this, enter the highest frequency in the useful part of the signal as the limit frequency for the **Lowpass** filtering mode. The lowpass filters out all the distortion frequencies above this limit.

The **Frequency Weighting (A-, B-, C-Filtering)** function executes digital filtering of a time-related signal in relation to frequency weighting curves. The frequency weightings A, B, and C describe the frequency-related sensitivity of the human ear to different acoustic pressures.

The **Frequency-Weighted Acceleration** functions calculate the extent to which measured vibrations affect the human body, in vehicles and at the workplace. For example, to test the extent to which vehicle vibrations affect drivers, you can mount various vibration sensors on the seat and use the **Frequency-Weighted Acceleration** function to analyze the measured acceleration signals.

Order Analyses

Use **Order Analysis** to analyze noises and vibrations that are measured on engines and engine components. In engine run-up tests, the relation between vibration and RPM is more important than the relation between vibration and time.

The **Order Analysis** functions compare the frequencies in a signal to a reference frequency. The calculated order specifies the multiple from the measured signal to the reference frequency. For example, the second order means that the analyzed frequency is double the reference frequency. As shown in the following figure, you can run order analysis in the time domain or in the frequency domain.

Figure 4-5. Results of Order Analysis as FFT Spectrum and Order Spectrum
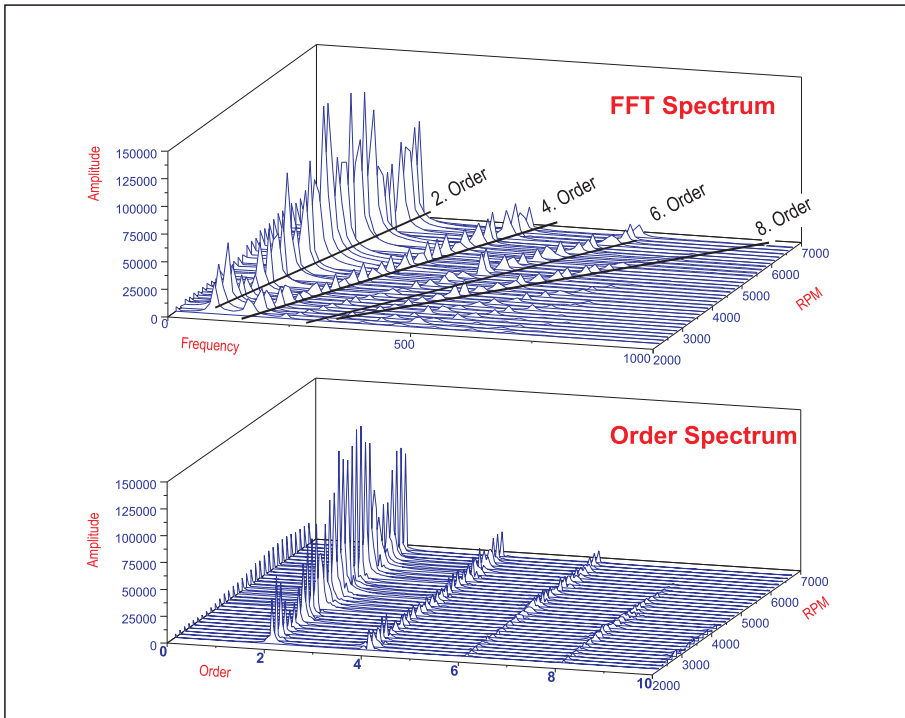
The **Order Analysis for Bode Display** calculates the amplitude and the phase position of the shaft vibrations, which you display over RPM in a Bode diagram in DIAdem VIEW.

Vibration Analyses of Rotating Shafts

The **AC/DC Coupling** determines the unbalance of a shaft by correcting the shaft movement of the orbit by the changes of the shaft position. The **Shaft Centerline** function calculates the movement of the shaft center in the bearing box and provides the data to identify whether the bearing clearance is critical. The **Pulse Detection** function analyzes the tachometer signal measured on the shaft and returns the corrected time points of the pulse. This function and the functions **Full Spectrum FFT** and **Order Analysis for Bode Display** are used for analyzing rotating shafts or for starting and stopping a turbine in order to recognize changes early and to thereby prevent damage. To do so, two vibration sensors offset by 90° measure the vibrations of the engine shaft.

Analyze the results interactively in DIAdem VIEW, as shown in the figure in section *Orbit and Shaft Centerline Axis Systems*.

Statistics Functions

The **Statistics** function group contains the **Descriptive Statistics** function for calculating the characteristic statistical values, such as the mean, the quantile, and the dispersion values. You can calculate the statistical characteristic values rowwise for several channels, for one entire channel, and for channel sections.

For example, you can test the pressure resistance of concrete. You run pressure tests on 25 blocks and measure the pressure under which the blocks crush. From the test results, you calculate the arithmetic mean, the standard deviation, and the lowest and highest pressure. DIAdem saves the calculated characteristic values in the custom properties of the input channels. You can drag and drop these custom properties into DIAdem REPORT in order to document the current statistical values in the report. In the dialog box, you can also enable the storage of results for each characteristic value in separate channels.

Use the **Process Capability** function to specify the process capability indexes Cp, Cpk, CpL, and CpU. You also can calculate the mean values and the standard deviations from the process, and various approximations for the number of incorrect parts. DIAdem stores the calculated characteristic process values in the appropriate variables and in custom properties of the input channels.

Classification Functions

The **Statistics** function group contains classification functions for determining frequency distributions for measured values. DIAdem divides the value range into classes, and counts how many measured values each class contains. DIAdem calculates histogram classification, single classification, reducing classification, compound classification, and Rainflow classification.

For example, you want to compare a series of engine tests on test rigs and in road trials. You select the required oil changes as the criterion. You count the oil changes per thousand kilometers and classify your results. The following figure presents the counts as a curve and the classification results as a histogram.

Figure 4-6. Classifying Two Test Series
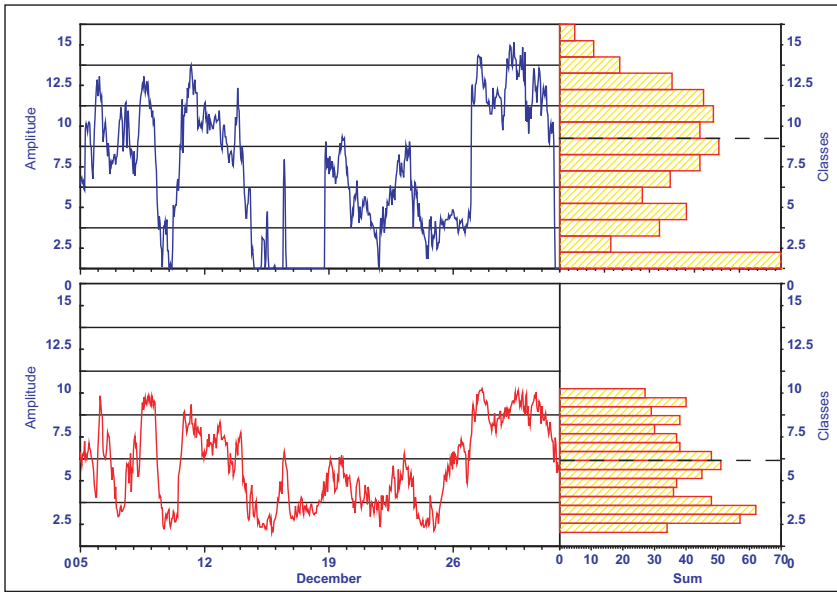
In a **Histogram Classification** you select the method with which DIAdem determines the classes to classify a channel. In **Single Classification** you also select the one-parameter classification method with which DIAdem classifies random oscillations. You can use the sample count, peak value count, time-at-level count, range count, or range pair count.

If you want to classify one or more channels that depend on the signal, but not the signal itself, you can use **Reducing Classification**. **Compound Classification** classifies two related channels simultaneously, not just one channel. The result of a compound classification is a 3D matrix.

Rainflow Classification

Rainflow Classification tests signals, in particular strain-time functions, for special events, such as overshooting strain levels, or strain changes.

If you test the duration of a spring, for example, you prepare a test schedule that subjects one hundred springs to oscillations ranging from 10 Hz to 10 kHz. You count the number of strain runs until the spring breaks. In the rainflow matrix, you enter the strain runs in relation to the oscillations.

3D Analysis Functions

The function groups **3D Basic Functions**, **3D Arithmetic**, and **Surfaces** contain 3D analysis functions for processing measurement data for a 3D display. DIAdem calculates the contours and the boundary curve from engine data for a characteristic diagram of an engine, as displayed in the following figure.

You can organize 3D data as triplets or as matrices in DIAdem. DIAdem executes the **Calculate Contour Lines** function with data in matrices or in triplets. DIAdem requires a matrix structure for 3D displays such as 2D matrix, contour lines, or waterfall displays. To display a 3D curve, DIAdem requires a triplet structure.

Figure 4-7. Characteristic Diagram with Isolines for Engine Performance and Fuel Consumption over RPM and Compression
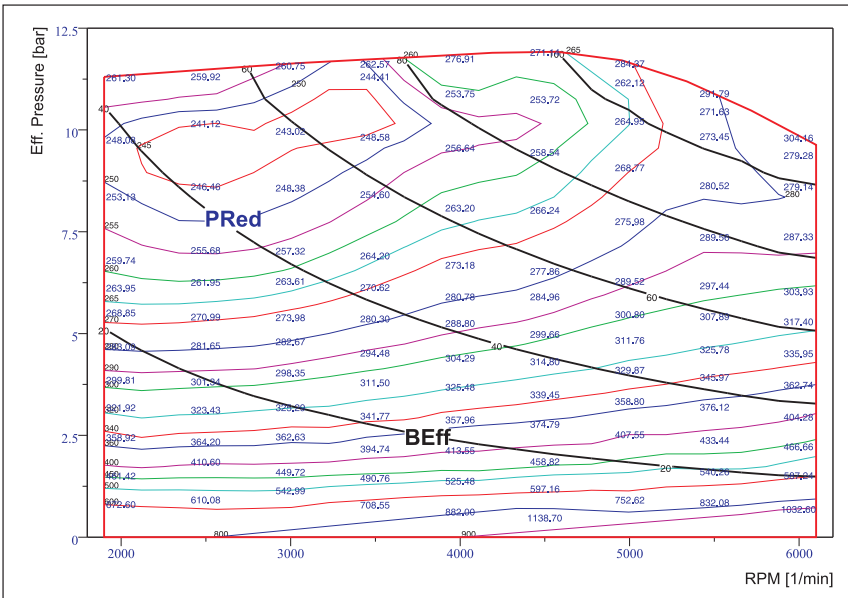
The **3D Basic Functions** include functions for converting the triplet structure into the matrix structure and vice versa (**Convert Matrix**). Use the functions **Create Submatrix**, **Append Matrix**, or **Sort Matrix** to process matrices. The **Transpose Matrix** function interchanges the rows and columns of a matrix.

The **3D Arithmetic** function group contains functions for calculating matrices. Use **Matrix-Matrix Operations** to add, to subtract, to multiply, or to divide matrices. Use the **Matrix-Vector Operations** to multiply a matrix by a vector algebraically or componentwise. Use **Matrix-Scalar Operations** to add a constant to a matrix or to multiply a constant by a matrix. The **Normalize** function normalizes elements of a matrix to the range [-1,1]. DIAdem divides all matrix values by the highest absolute value in the matrix. Use the **Relativize** function

to calculate what part of the total sum of all matrix elements each element in a matrix is, as a percentage. Use the **Summation** function to summate the values in a matrix in rows and columns.

The **Integrate** function calculates the volume under a surface that is given by a matrix. DIAdem calculates the integral by adding up the volumes of all the partial rectangles in the xy-grid. The **Calculate Extreme Values** function calculates the minimum values and the maximum values in a matrix.

The **Surfaces** function group contains the **Interpolate** function that approximates three-dimensional data with an interpolated surface, and the **Approximate** function which approximates a surface for three-dimensional data with the error square method using a setup function. The interpolated surface runs exactly through the points of the three-dimensional data. The approximation function minimizes the distance between the surface and these data points to create a smoothed surface.

The **Calculate Contour Lines** function connects the points with the same height on a surface. If the three-dimensional data is in a matrix structure, DIAdem creates a grid of rectangles. If the three-dimensional data is in a triplet structure, DIAdem uses a triangulation as the basis to calculate a surface for the contour lines. You can calculate contours for the entire grid or for a subsection.

Use the **Calculate Convex Hull** function to calculate a convex or a non-convex hull for a set of points. The convex hull encloses the points as a closed polygon. The non-convex hull also encloses the set of points, but is indented.

Crash Analysis Functions

The **Crash Analysis** function group contains functions for analyzing measurement data from vehicle safety tests. You can use the functions to calculate standardized injury criteria. For example, use the Head Injury Criterion to assess head injuries, the Neck Injury Criterion for the neck area, the Viscous Criterion for the chest area, and the Tibia Index for the leg area.

The calculations are executed according to the current SAE, ISO, and NHTSA specifications. For digital phaseless filtering, you can choose from CFC60, CFC180, CFC600, CFC1000, and FIR100.

The example **Crash Evaluation Based on the MME Standard** shows an analysis of test data for vehicle safety, in a report. You can start this application example in the DIAdem help. This example uses a script to guide you through the analysis of a front or side impact, in three steps. The following figure shows the report for head acceleration in frontal impact.

Figure 4-8. Crash Analysis of the Head Acceleration in a Frontal Crash for the Head

5
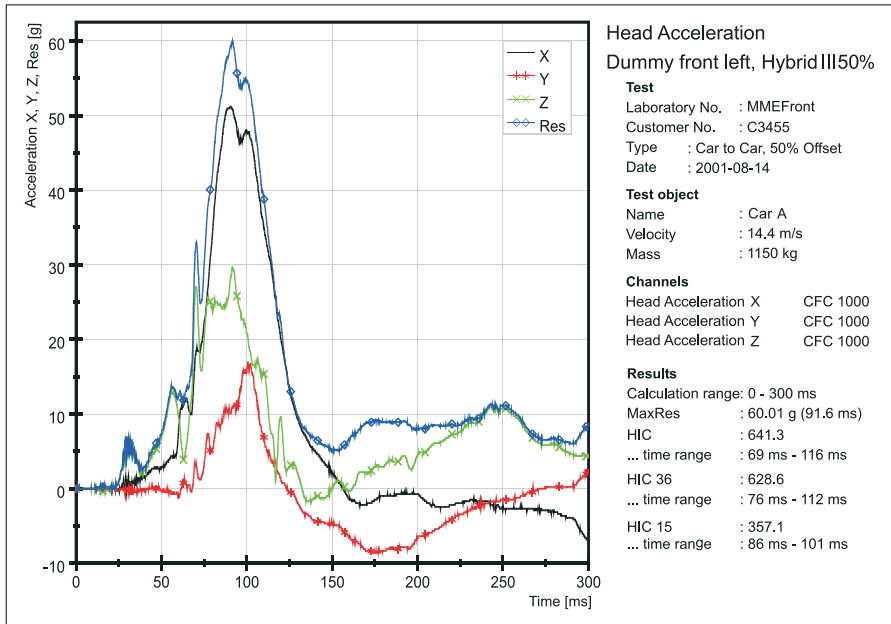
Creating Reports

You use DIAdem REPORT to create multi-page reports of data and events. You can use two-dimensional and three-dimensional axis systems, polar axis systems, tables, text, variables, formulas, and graphics to document and to present data.

Figure 5-1. DIAdem REPORT
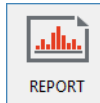
Worksheet Design

Report worksheets can have various displays and changing page orientation. You save the design of all the worksheets of a report and the links to the report data, in the layout file. You can reuse stored layouts as templates for similar reports.

To display data as curves in a 2D axis system, for example, open the **2D Axis Systems** function group and click the **Simple 2D Axis System** button. A small rectangle appears next to the cursor. Click and drag open a frame at the position where you want to insert in the 2D axis system in the worksheet.

Figure 5-2. 2D Axis Systems
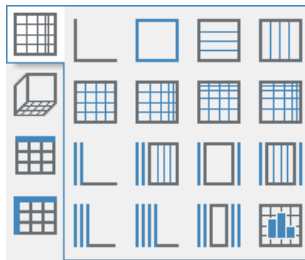
To display a curve, drag and drop a channel from the Data Portal into the axis system. DIAdem REPORT displays numeric channels with the index and waveform channels with the x-part. Click the x-channel `Time` in the Data Portal to display the temperature over time and then the y-channel `Temperature`. Drag and drop these channels into the axis system.

To display one or more channels with the same x-channel, first click the x-channel `Time` in the Data Portal. Then press Ctrl and click the numeric y-channels, for example, `Pressure`,

Temperature, and Revolution. Drag and drop these four channels into the axis system. DIAdem REPORT displays the pressure, the temperature, and the rpm as curves over time. If you drop a channel group onto an axis system, DIAdem selects the first channel in the channel group as the x-channel. If you drag and drop several waveform channels onto an axis system, DIAdem displays each waveform channel over its x-part.

If you want to display a curve over a text channel, select from the Data Portal a text channel that contains, for example, the names of the months and a numeric channel that contains, for example, the monthly precipitation and drag and drop these channels onto the axis system. DIAdem REPORT displays the precipitation over the months and labels the x-axis with the names of the months that the channel contains.

To create another worksheet, double-click the tab on the right side of the name of the last worksheet. To create a new worksheet with the layout of the current worksheet, right-click the tab with the name of the worksheet and select **Copy** from the context menu. Use **Manage** from the context menu to change the order of the worksheets and to rename and delete worksheets. To insert worksheets from an existing layout, select **File»Append Layout**. In the Manage Worksheets menu, you can select several worksheets and delete them from the report. Use the filter function to find and display a specific worksheet.

You can print reports, or you can export a report as a graphic file, an HTML file, a PDF file, an XPS file, or a PowerPoint file. To save the current worksheet as a graphic in one of the common formats, click **Export** on the toolbar and select **Graphics Export**. To save the entire report as an HTML file, select **HTML Export**. DIAdem creates an HTML file with the names of the graphics files created in each worksheet. To save the report as a multipage PDF file, DIAdem uses the PDF printer driver. With MS Windows 10, you can use the Windows PDF printer if you enable the setting **Create PDF files with Microsoft printer** under **Settings»DIAdem Settings»REPORT**. From Windows version 7, you can save the report as an XPS file. PDF and XPS files are formats that are independent of platforms and therefore retain the fonts, graphics, and formats on every operating system. If you want to save the report as a PowerPoint presentation, MS Office with PowerPoint must be installed on your computer. Under **Settings»Layout Setup»Layout Parameters** you can add custom properties to a report, for example, the name of a test sequence, in order to search for this property with the DataFinder.

Using the Chart Wizard

Use the Chart Wizard to display data in 2D axis systems or in polar axis systems. In three steps you select the type of diagram, specify the channels with the data to be displayed, and specify the display.

If you enable the preview, DIAdem shows how each setting you make in the Chart Wizard affects the worksheet. If you click **Finish**, DIAdem applies the settings to create a new worksheet or a new axis system. If you click **Cancel**, DIAdem restores the original status.

You can open the Chart Wizard at several points in DIAdem REPORT. If you want to create a new worksheet, open the Chart Wizard from the DIAdem REPORT toolbar. If you want to display the channels selected in the Data Portal, open the Chart Wizard from the context menu

of the Data Portal. If you want to insert a 2D axis system or a polar axis system in a worksheet, open the Chart Wizard in the **2D Axis Systems** function group or the **Polar Axis Systems** function group. If you want to edit a 2D axis system or a polar axis system, open the Chart Wizard from the context menu of these axis systems.

Editing Objects

You can position and resize objects such as axis systems, tables, text, graphics, and lines anywhere in the worksheet. As soon as the cursor idles on an object, DIAdem displays a blue frame for you to identify which object you select when you click. To resize an object, click the object. DIAdem selects the object and frames the object with a dashed line that has small squares in the corners and at the sides. Drag the squares at the sides to change the width or the height. Drag the squares at the corners to resize the object while maintaining the proportions. Press <Ctrl> at the same time to change the size but keep the center.

You can select several objects and move and resize them together. You can align selected objects to each other and align the size of the objects. The dashed frame around the object group is the reference point for DIAdem. To make an axis system and a table the same width, click the **Alignment** button on the toolbar and select **Width**. If the table is below and to the right of the axis system, the axis system provides the left edge and the table provides the right edge for the joint width.

Most objects consist of several subobjects, such as axes, axis text, and curves. You can select and edit each subobject. You can move a selected axis text, format the text with the format bar, or double-click the text to open the dialog box where you can change the text.

You can edit the common properties of several selected objects. If you select an axis text and a heading, you can change the font for both texts on the format bar simultaneously. However, if you select an axis system and a text, for example, you cannot configure the objects because the objects do not have any common properties.

Displaying Objects

You can superimpose axis systems, tables, text, and graphics in a worksheet. The superimposed objects are visible because the backgrounds are transparent. To highlight a text in an axis system, select **White** for the text background.

DIAdem displays objects in the order that you insert the objects into the worksheet. The new objects are in the foreground. You can change the order for each object. To position a new graphic behind an existing axis system, for example, right-click the graphic and select **Move to Background** from the context menu.

Use the **Preview** in the dialog boxes to view the settings directly in the worksheet. To do so, move the dialog box on the monitor or hide it altogether except for the title bar. To do so, click the arrow in the title bar next to **Close**.

Numeric Formatting

Use format definitions to specify the display of numbers on axes and in tables. You select the numbers you want to format in the worksheet and select the type of numeric display in the dialog box. To format the numbers in a table, double-click the numbers in a column. DIAdem opens the table definition on the **Column Properties** tab. To use a format definition, click the button with the three dots, which is next to the format entry field. Select, for example, **Number** as the category and set 2 as the number of decimal places. DIAdem displays the numbers in this column as decimals with two places after the decimal point. You can also display the numbers as exponential, binary, or hexadecimal numbers, or as a percentage,

To format time data, use the categories **Date**, **Time**, or **Date/Time**. Select a **Region** to specify whether the date and the separators are displayed according to the European, Japanese, or to the North American standards. To adapt a format, complete the following two steps. Select the format definition closest to the format you want, for example, `June 01` in the **Date** category. Stay in the dialog box and select the category **User-defined**. Change the format `#ttt YY` to `#ttt YYYY` and check the **Preview** to see whether DIAdem displays the date with a four-digit year.

Variable Formatting

Use the `Str` function to display formatted numeric variable contents. For example, to display the current median value with four decimal places, enter the following line in a report:

```
@@Str(StatMedian,"d.dddd")@@
```

The `Str` function converts the numeric contents of the `StatMedian` variable into text. The format definition `d.dddd` rounds off to the fourth decimal place. For DIAdem, the `@@` characters indicate a variable expression.

Formatting with User Commands

Use user commands, for example, to display data in a special format unknown to DIAdem. You define user commands in DIAdem SCRIPT. Refer to the section on *Defining User Commands* in Chapter 6, *Automating Sequences* for more information about user commands.

The following figure displays the same data in two axis systems that have x-axes in different formats. The top axis system displays the time in hours, and the bottom axis system displays the time in days after 5,000 hours. The user command `CalcTime` from the `UserCmdReport.vbs` script creates the second formatting. The format specification for the x-axis in the bottom axis system contains the following command call with `CFV` (abbreviation of `CurrentFormatValue`) for the value to be formatted:

```
@@CalcTime(CFV,CAxN)@@
```

Figure 5-3. User Commands Format the Time Axis
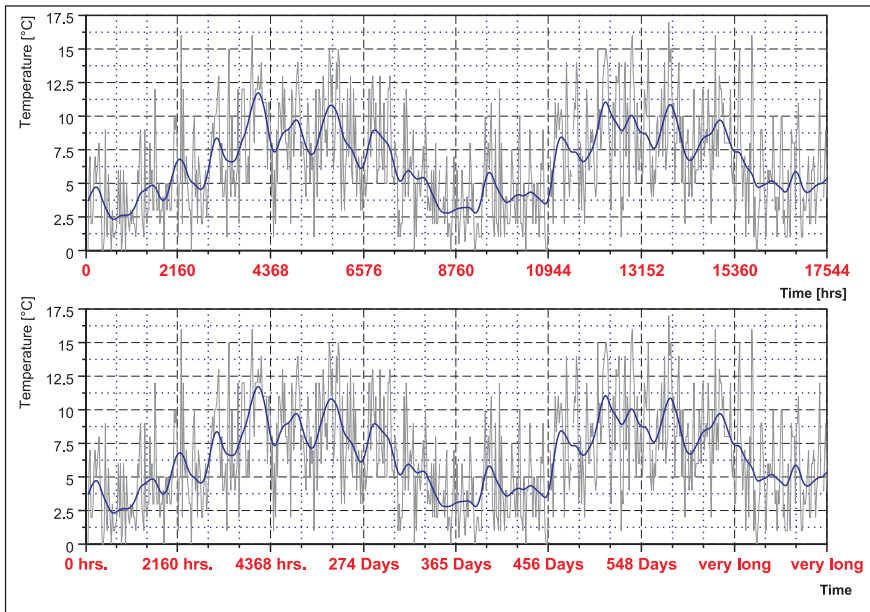
To execute user commands when the report refreshes, select **Settings»Layout Setup»Layout Parameters»Events** and enter user commands as **Commands to be executed**. User commands can format axis systems and tables, and can also read information from databases and execute calculations.

Editing Layouts

You save the descriptions of all the worksheets of a report in a layout file with the filename extension `.tdr`. The layout file contains descriptions of all objects, such as axis systems, tables, or text, and the data links. You can change or delete data assignments in the dialog boxes for the axis systems and tables.

By default, DIAdem uses the channel name and the group index to assign the data channels in the report. This works well if the channels in the evaluated data files always have the same name and are always in the same channel group. If the channel group is not always at the same position in the data files, but the group always has the same name, the channel assignment can also consist of the group name and the channel name. A report can also include channel references that consist of the group name or the group index and the channel index. Specify the name-oriented channel assignment under **Settings»DIAdem Settings»General**.

If you enable curve expansion in the layout parameters, DIAdem displays the curve of the first matching channel pair in a channel group and also the curves of all channel pairs with the same name in all channel groups with an entry in the curve definition. After you define the channel assignment for an axis system, DIAdem searches the Data Portal for the first channel that has the specified x-channel name, such as Time. When DIAdem finds the x-channel, DIAdem searches for the associated y-channel Speed in the same channel group. In the expansion mode, DIAdem searches to the end of the Data Portal for other Time and Speed channel pairs in the other channel groups. Select **Settings»Layout Setup»Layout Parameters»Display»Curve Expansion** to specify the attributes for each curve display.

Creating Templates

Specify the layout on the various tabs in the layout setup. Specify the size and orientation of the worksheets and also the outer frame and a background color on the **Worksheet** tab. If you add further worksheets to the report, DIAdem uses these global settings for the new worksheets. You can change, for example, the orientation of a worksheet under **Settings»Layout Setup» Worksheet Parameters**. Use the portrait format for tables, but keep the landscape format for diagrams in the other worksheets.

Create a master layout to match the appearance of reports to your corporate design. While you create your report, the master layout remains in the background and cannot be modified. To create a master layout, select **File»Master Layout»New**. A master layout consists of a **Landscape Master** and a **Portrait Master**. Design a master layout with graphics such as logos and sketches, with frames and lines, and with text such as the author, date, or test number. These details all appear on each sheet of a report. You can also use variables to automatically include the current date or the name of the data set. Select **File»Master Layout»Save As** to save the master layout with the filename extension .tdrm. Go to **Settings»Layout Setup»Layout Parameters** and select **Master Layout** to add a master layout to a report. Click **Select Master Layout** to load a master layout. Click **Refresh Master Layout** to apply the modified master layout settings. Click **Remove Master Layout** to remove the master layout from the report.

You can use the layout file as a template for other reports that have data in the same structure. If you select **Settings»DIAdem Settings»REPORT**, you can specify a template file in addition to the start file that DIAdem REPORT displays when launching. DIAdem uses the template when you select **File»New** to create a new report. The template can contain standard objects such as axis systems and also a master layout.

Page Format

In DIAdem REPORT, you specify the page format as relative or as scaled. A relative page format specifies the worksheet size as the height of the worksheet in relation to the width. Enter the width of the printout in relation to the selected paper format in the print dialog box. The DIAdem REPORT default settings specify a ratio of 0.7 for A4 landscape format or 0.77 for letter landscape. Select **User-defined** as the page size if you want to change the ratio. If you change the ratio, you move the objects in the report because you specify the position of the object as the distance from the edge as a percentage of the width and the height of the worksheet.

For scaled page format, select **Settings»Layout Setup»Layout Parameters»Worksheet** and enter a fixed height and a fixed width for the worksheets. DIAdem always prints the worksheets in the specified size, regardless of the paper format. If you select a scaled page layout, you can scale an axis system manually to ensure that DIAdem always prints the same number of units per centimeter, for example, 10 °C/cm.

Inserting Report Objects

In the function groups, DIAdem REPORT provides predefined objects that you can configure. The following objects are arranged by category in the DIAdem REPORT function groups:

- 2D axis systems
- Polar axis systems
- 3D axis systems
- 2D tables
- 3D tables
- Text
- Graphics
- Circles, rectangles, lines, and arrows

Inserting Axis Systems

Axis systems display channels as curves and as bar diagrams. Use a 2D axis system to display velocity over time as a curve. Use a polar axis system to display the sensitivity of a microphone in a circle diagram. Use a 3D axis system to display a characteristic diagram of engine performance over the rpm and the compression.

2D Axis Systems

Use 2D axis systems to display channels as two-dimensional curves or as two-dimensional bar diagrams. You usually enter an x-channel and a y-channel for a curve. The x-channel is often a time channel. You can also use any other channel as the x-channel, for example, the frequency of a spectral analysis or a text channel with the names of the samples. DIAdem assigns the corresponding y-value to each x-value. If the two channels are not the same length, the curve is as long as the shorter channel. If you specify only the y-channel, DIAdem REPORT displays a numeric channel with its index and displays a waveform channel with its x-part.

You can combine various display types in one axis system. To edit the display, double-click the axis system. Click the **Type** column to open the dialog box with the curve parameters. Select a display mode and configure the display on the respective tabs. Use a bar diagram to display a statistical evaluation as a histogram. Numbers above the bars show the frequencies of the individual results. A horizontal line in the axis system represents the arithmetic mean. Use a curve display and error deviation to illustrate the reliability of the calculated results. DIAdem displays error bars on one side and on both sides of the curve, for the x-values and for the

y-values. Use a filled area to highlight the surface between two curves, which represents the norm range of the test value.

 Use the **Coordinate** display mode to highlight conspicuous points like outliers, and to add a comment. To mark the highest value of a curve, right-click the highlighted curve and select **Add Curve Coordinate»Absolute Maximum** from the context menu. DIAdem creates a comment with the x-value and y-value of the maximum. Double-click the text frame of the comment and enter a descriptive text. If you move the axis system or change its size, the comment arrow continues to point to the maximum.

You can use colored background segments, for example, to display changed test conditions in an axis system. To do so, double-click the axis system and select **Background Segments** on the **Axis System** tab. Select two channels from which DIAdem reads the state and the position of the segments, and specify the background color and the direction of the segments parallel to the x-axis or the y-axis. If you specify several segments, specify the transparency of the color in such a way that all colors are visible if the segments overlap.

Use graphics in a report to illustrate data in and next to axis systems and tables. In 2D axis systems, you can connect the background graphics with the value ranges in such a way that graphics are automatically adjusted to the axis scaling and axis units. To do so, click the three dots next to the setting **Background graphic** on the **Axis System** tab in the curve and axis definition dialog box. Enter the start and end values of the value range of the graphic including the unit. Use the scalable background graphics to display, for example, geo data on a map or, as shown in the following figure, to highlight the numeric values of a color spectrum with appropriate color values. The background graphic shows a light spectrum in the range 400 nm to 750 nm, which is visible to the human eye. The various axis systems display the different sections of this light spectrum and DIAdem displays the part of the background graphic which matches the respective value range.

Figure 5-4. Axis Systems Showing Scaled Extracts of the Visible Light Spectrum as Background Graphics
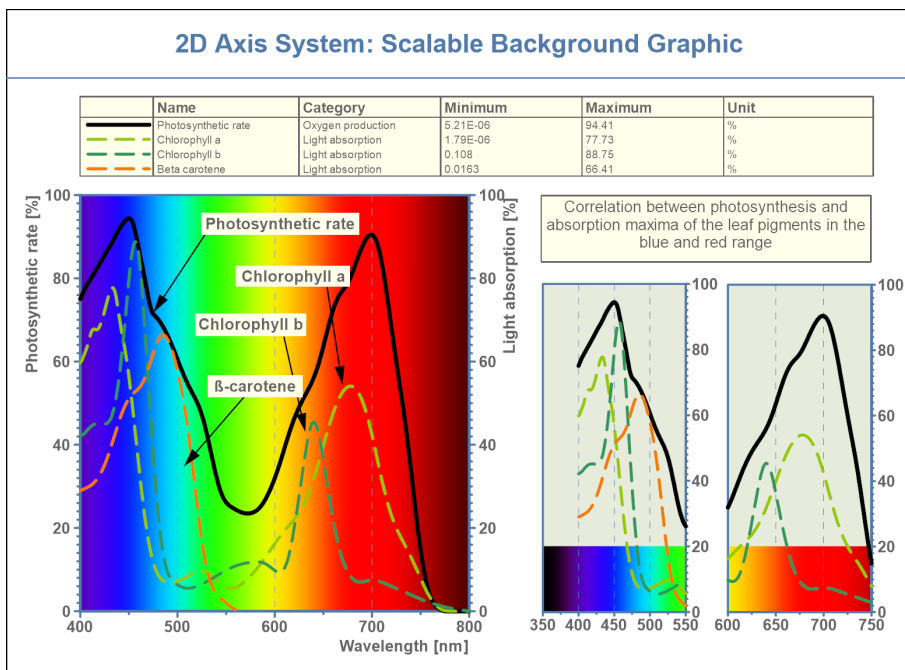
With automatic scaling, DIAdem REPORT displays the entire channel as a curve. Use manual scaling to zoom a section. Open the **Axis Parameters** with a double-click on one of the two axes. Specify the first and the last values to be displayed and select the scaling mode for the x- and the y-axis respectively. The x-axis scaling and the y-axis scaling can differ, as is the case in a semi-logarithmic display.

To scale an axis interactively, position the cursor above the scale of the x-axis or of the y-axis. The cursor appears as a double arrow next to the scale. Rotate the mouse wheel to expand or to shrink the scale. If you position the cursor at the center of the axis, you modify the scale at both ends of the axis. If you position the cursor at the lower end or the upper end of the axis, you scale the axis at the selected end, while the opposite end remains fixed. Right-click the axis and select **Scale Axis Automatically** to restore the original value range for this axis.

One axis system can include several curves. You can define curves with the same x-channel or with different x-channels. Use subaxes if the axis system contains y-channels that have different value ranges and different units. Click **New Subaxis Left** or **New Subaxis Right** on the **Axis Position** tab to display channels with different measurement units in one axis system. Assign a y-axis to each curve on the **Curve List** tab.

The following figure shows a separate subaxis for each test parameter in an engine test, because the CO emission, fuel consumption, and exhaust temperature each have different dimensions. Select all temperature channels in the Data Portal and drag and drop the selected channels onto the bottom left y-axis. Then select the CO emission channels and drag and drop these channels onto the top left y-axis. Each subaxis has a separate scale. If you enlarge or reduce the size of subaxes, DIAdem REPORT adjusts the curves.

Figure 5-5. Engine Test Evaluation with Subaxes
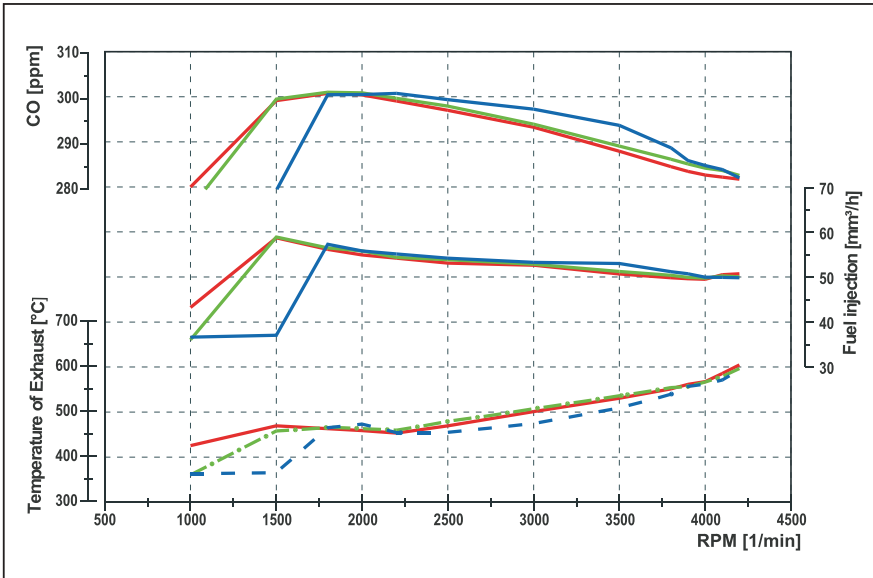
Use the DIAdem units catalog to compare temperature channels that have different units such as Celsius, Fahrenheit, and Kelvin in one axis system. The units catalog defines the different units of a quantity and describes how DIAdem converts one unit into another unit. Double-click the axis system and open the **Axis Parameters** tab. Click **y1 Axis»Scaling** in the tree display. Enter for **Unit** the symbol °C for celsius from the units catalog, which opens when you click the three dots at the end of the input field. DIAdem converts all the temperature channels into the unit Celsius and hides all the channels that have other quantities. If you want to show this report to American colleagues and customers, change the unit to degrees Fahrenheit °F. In the same way you can specify the unit for the x-axis. Refer to *Using the Units Catalog* in Chapter 2, *Finding and Managing Data*, for further information about the units catalog.

You can use curve transformations to edit channels before DIAdem displays the curves and without DIAdem modifying the original data. To do this, create a script with the functions you want to use, and register the script as a user command in DIAdem. To smooth a curve with a curve transformation, for example, double-click a 2D axis system. Click the **Enable Curve Transformation** button on the **Curve List** tab to display the column with this name. Click the button next to the curve definition, and enter the user command CurveSmooth. When DIAdem

refreshes the report, DIAdem smoothes the curve with the specified user function. Refer to the section on *Defining User Commands* in Chapter 6, *Automating Sequences* for more information about user commands.

Polar Axis Systems

Use polar axis systems to display curves in circle diagrams. Select one or two channels in the Data Portal for a polar axis system. In channel pairs, the x-channel contains the angle and the y-channel contains the radius.

 The following figure shows different reception ranges for two microphones. The polar axis system shows how the sensitivity of the microphones, which are positioned at the axis origin, depends on the direction of the microphones. You can define polar axis systems as semicircles, quarter circles, or with any angle from 0-360°.

Figure 5-6. Comparing the Reception of Two Microphones Placed in the Origin of the Polar Axis System
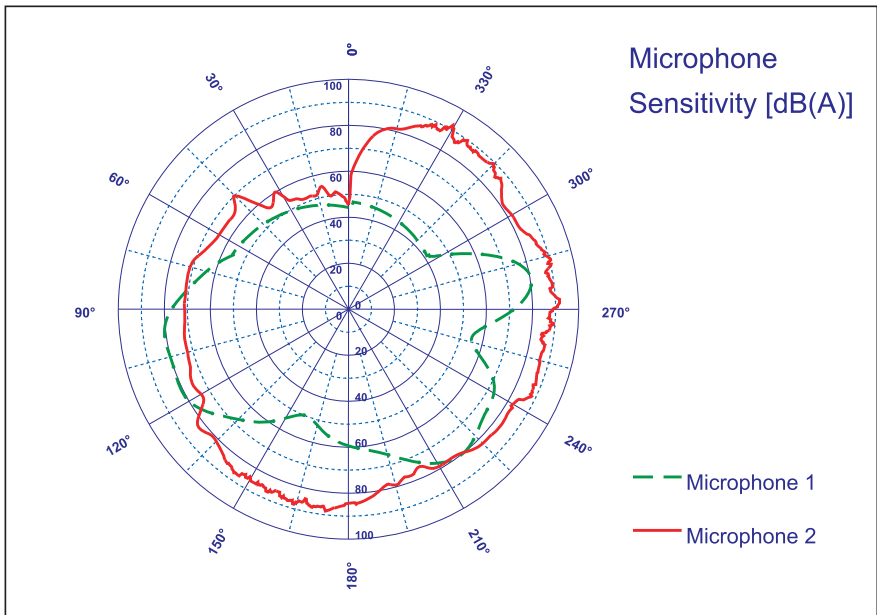
As in a 2D axis system, you can interactively scale the amplitude with the mouse wheel, depending on the position at which you move the cursor over the axis labeling.

3D Axis Systems

Use 3D axis systems to display, for example, characteristic diagrams of engine power or waterfall displays of order analyses. For further diagrams of these functions, refer to the description of the *Function Libraries* in DIAdem ANALYSIS in Chapter 4, *Analyzing Data with Mathematical Functions*.

To edit the display, double-click the axis system. Click the **Type** column to select a display mode, such as surface, isolines, bars, spikes, 2D matrix, vector, or symbol. To edit the display, click the button with the three dots and specify the curve parameters. Use the **Coordinate** display mode to highlight conspicuous points, such as plateaus or outliers, and to add a comment. When projecting onto a plane, you can set the coordinates interactively in the context menu as you do in a 2D axis system .

The following figure shows a combination of several displays of a spiral in a 3D axis system. To display the spiral as a 3D curve, select three channels in the 3D axis system dialog box. The arrows on the spiral are vectors that display the force for each point on the spiral. The xy-plane and the xz-plane show the spiral projections. You can specify the scaling, the labels, and the grid display for each display plane. As in a 2D axis system, you can interactively scale the axis with the mouse wheel, depending on where you move the cursor over the axis labeling.

Figure 5-7. Vector Display of a Spiral with Projections onto the Planes
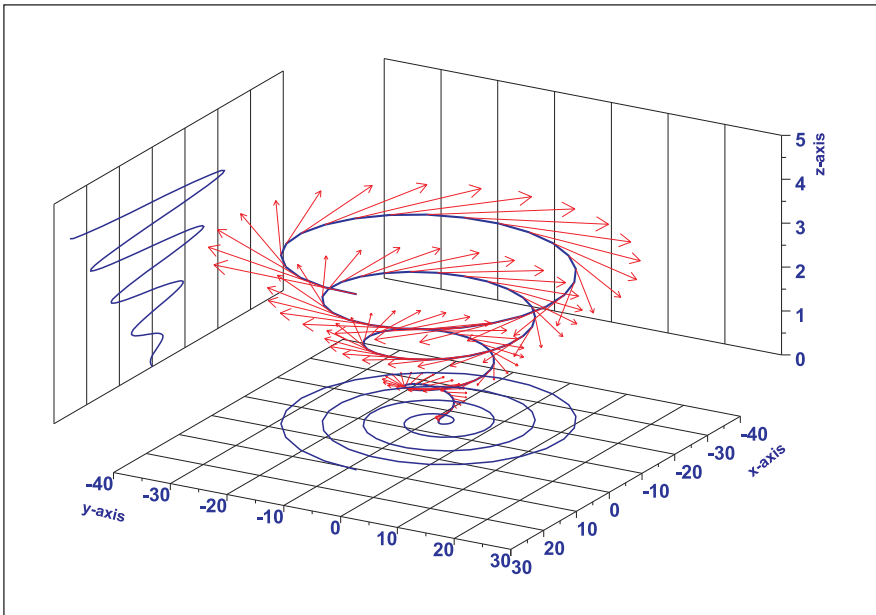
You can rotate and move 3D axis systems in the worksheet and move the coordinate planes. To change the view of a 3D axis system, click the 3D axis system and rotate the axis system. To move a 3D axis system, click outside the axis system, but inside the selection frame. If the mouse cursor does not show interlocked circles with arrows, you can move the axis system. To move a plane outwards, click the edge of the plane. As soon as the layer displays a blue selection frame, move the layer outwards.

The data must be in a matrix structure for a waterfall display, a bar display, and a 2D matrix display. In the dialog box for the 3D axis system, you select an x-channel, a y-channel, and as many z-channels as the y-channel contains values. If DIAdem displays 3D curves, the data must be in triplets, for which you select three channels. The display types surface, spike, symbol, and characteristic diagram can display data in triplets and in matrices. You can use the 3D analysis functions in DIAdem ANALYSIS to convert channels into a matrix or a triple value.

Inserting Tables

2D tables list the contents of all the channel types and variables. 3D tables display numeric data as matrices. You can align a table horizontally or vertically.

2D Tables

Use 2D tables to list numeric channels, waveform channels, time channels, and text channels. Drag and drop channels from the Data Portal into the table. Double-click the table to open the table definition where you change the order of the columns, specify the display parameters, and enter the headings. For long channels, you can specify the first value, the last value, and the step width between the values to be displayed. To change the column widths or the height of the headings, move the separators. To change the text attributes, select the column entries or headings and select, for example, the font in the format bar. You can display data in ascending or descending order, and convert units, for example, temperature channels from Celsius to Fahrenheit, with the units catalog like in a 2D axis system.

To display long channels in total, select **Auto increasing** as the table length on the **Scaling** tab in the table definition dialog box. This defines a table that lists the channel contents on several sheets. Use the functions of the **Table Navigation** on the DIAdem REPORT toolbar to scroll the pages of the table.

You can also display scalar variables and vector variables in a 2D table. Click the **Table Columns** tab, select **Variable** as the data type, and enter the variable name. If you enter the CurrDate scalar variable in the dialog box, the current date appears in the top row of the table. If you enter the CD vector variable, DIAdem displays the units of all the channels in the Data Portal, in the table column.

Use the text lists in 2D tables to display texts and expressions separately from channels in tables. Select the **Text list** data type on the **Table Columns** tab. Create as many rows on the **Column Properties»Text List** tab as you need for entering your text. Click the button with the three dots to insert variables and expressions. Always set double @ characters at the beginning and at the end of each variable. DIAdem saves these text lists with the report layout.

3D Tables

Use 3D tables for numeric display of the matrix structure of 3D data. Enter an x-channel, a y-channel, and the first z-channel of the matrix structure, in the 3D table definition dialog box. The following figure shows how a 3D table assigns the associated z-value to each xy-value pair.

Figure 5-8. 3D Tables Assign the Associated Z-Value to Each XY-Value Pair

Temp. (°C)	Pressure (mbar)							
	0.01	0.06	0.11	0.16	0.22	0.27	0.32	0.37
0.00	0.09	0.10	0.07	0.03	0.01	0.00	0.00	0.00
0.05	0.14	0.19	0.11	0.03	0.01	0.02	0.02	0.01
0.10	0.15	0.33	0.11	0.00	0.02	0.08	0.05	0.03
0.15	0.07	0.08	0.01	0.10	0.03	0.09	0.13	0.12
0.20	0.04	0.03	0.17	0.31	0.14	0.07	0.15	0.26
0.25	0.13	0.21	0.43	0.63	0.26	0.06	0.25	0.41
0.30	0.21	0.37	0.45	0.39	0.16	0.14	0.37	0.55
0.35	0.17	0.20	0.16	0.07	0.03	0.27	0.50	0.65

(Column at left: Concentration (mol/l))

The 3D table can display the entire matrix structure or a section. You specify the display parameters such as font and display format for the x-values, the y-values, and the z-values. To display 3D data in triplet structure, list the three channels in a 2D table, in which every column contains one channel and every row contains one value triplet.

Adding Text, Comments, and Formulas

To create a text, you can use texts, text objects, or comments. Use text to create uniformly formatted text such as titles, use the text object to create multiline text in different formats, and use comments to place labels at prominent points in the worksheet. Use formula graphics to add mathematical calculation instructions to the report.

All texts can include special characters, formula expressions and DIAdem variables, which DIAdem refreshes with the rest of the report. For example, to display the current time, insert `@@CurrTime@@` in a text. The `@@` characters indicate to DIAdem that `CurrTime` is a variable. You can use user variables as well as program variables and auxiliary variables. Refer to the section on *Using Variables* in Chapter 6, *Automating Sequences*, for more information about variables.

Text
Use text to insert text, headings, or subtitles in a uniform format. Select **Text»Text**, click the text cursor in the worksheet, and enter `Ribs Left` as the heading, as shown in the following figure. If the text cursor is activated and you press <Enter>, DIAdem generates another line, where you

enter the subtitle `Dummy front left, Hybrid III 50%`. To end the text entry, click anywhere in the worksheet.

Use the format bar to format the selected text. To rotate text, click one of the squares at the corners of the selected text and rotate the text to the right or to the left with the curved arrow. Double-click a text to edit the contents.

Figure 5-9. Crash Test Report with a Heading and a Text Field
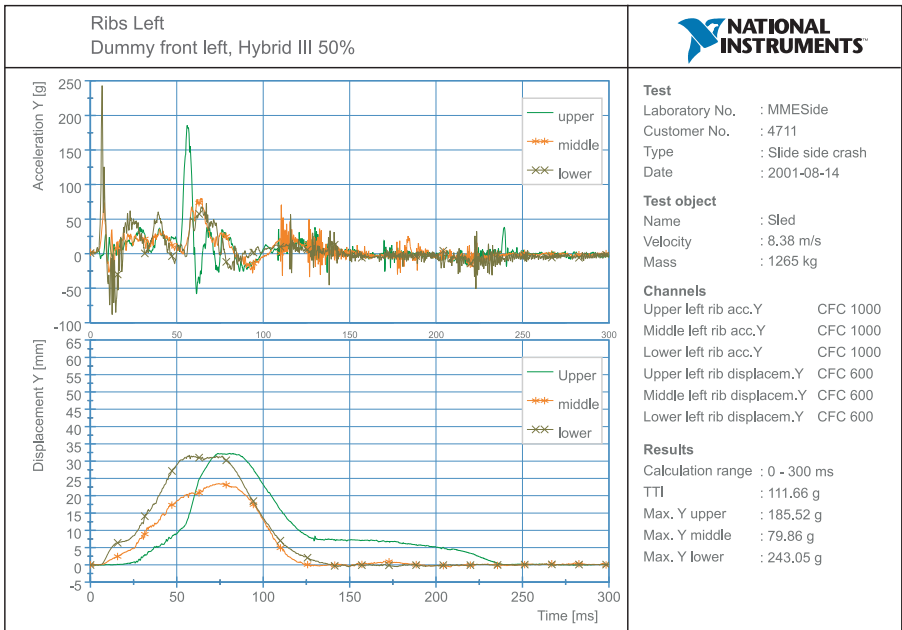
Text Objects

Use text objects to create a single text with different formats.

To create a text object, select **Text»Text Object**. DIAdem inserts a white field into the worksheet. Double-click the text object and enter a text. The text object editor offers functions for formatting single words and paragraphs. The functions for formatting are located on the toolbar of the dialog box. Structure your text with list items, indentations, and paragraphs.

You cannot format text objects on the format bar; you can only format them in the text object editor. You also define the font size differently for text objects than for text or for axis labels. You specify the font size for the text object as absolute but the font size for the text as relative to the worksheet. If you zoom text, you enlarge the text itself. However, if you zoom a text object, you only change the layout, not the size of the text.

Comments

Use comments to highlight key items in your worksheet. To create a comment, select **Text»Comments**. Drag open a frame where you want to position the comment on the worksheet. DIAdem creates an arrow with a text frame. Double-click the text frame and enter a text. Enter the font size as an absolute value. Use the format bar in DIAdem REPORT to format comments.

If you anchor the end of the arrow, the arrowhead does not move when you move the comment. To reposition the arrow, click the arrow and move the square on the arrowhead.

If you select and delete the arrow, you get a comment frame. Unlike text, a comment frame remains the same size regardless of how much text you enter. If the text exceeds the frame size, DIAdem wraps the text and only displays the text that fits in the frame.

Formula Graphics

Use formula graphics to add a mathematical formula to the report. To create a formula graphic select **Text»Formula Graphic** and drag open a frame in the worksheet where you want to position the formula. Double-click the formula graphic and enter the formula into the input field on the **Text** tab. You can enter the formula as you do in the Calculator, for example, the square root calculation as $y=SQR(x^3)$. The preview shows the mathematical display of the formula as it appears in the worksheet. You enter more complex formulas and expressions in the Mathematical Markup Language (MathML) in which DIAdem saves the formulas in the report file. You can frame the formula graphic and add an arrow. The size of the frame determines the size of the formula display.

Adding Graphics, Lines, and Predefined Objects

Use graphics to include a diagram of a test stand or a company logo in your worksheet. You can use the **Graphics** function group to load graphics in common formats. You can position graphics behind axis systems and tables, because these objects generally have transparent backgrounds.

When you insert graphics, DIAdem generates a link to the graphics file. DIAdem saves the link with the path in the layout. If you want to use a layout on another computer, embed the graphic into the layout file. To do so, double-click the graphic and enable **Embed graphic in layout when saving**.

Use frames to highlight a label text or a heading in the worksheet. To plot a frame with any page ratio, select **Circles and Rectangles»Rectangle**. Drag open a frame anywhere in the worksheet.

Each worksheet has an outer frame. To hide the outer frame, select **Settings»Layout Setup» Layout Parameters** and disable **Display frame**.

To insert a circle into the worksheet, select **Circles and Rectangles»Circle**. Drag open the circle anywhere in the worksheet. To make an ellipse from a circle, disable the **Force circle** checkbox in the circle dialog box. Then drag the squares at the sides of the frame to change the width and the height.

Use lines and arrows to partition the worksheet with lines or to indicate points in the worksheet with arrows. The **Lines and Arrows** function group contains various types. For example, select an **Arrow** and drag open a frame where you want the arrow to start, in the worksheet. You can move the start point and the end point of the arrow with the mouse. To change an arrow into a double arrow, select another arrow for the start point in the dialog box with the arrow settings. To change an arrow into a line, select **No arrow** as the end point in the dialog box with the arrow settings. To define a description field on the right side of the worksheet, click **Continuous Vertical Line**, and to define a description field at the bottom of the worksheet, click **Continuous Horizontal Line**.

The **Predefined Objects** function group contains predefined texts, for example, to add a page number to the bottom of a report page or to add a heading. You can also add the date and the time, the name of the report file, and the data file loaded in the Data Portal. If you created a multipage report, click **Table of Contents on New Page**. DIAdem adds a new worksheet which lists the page names of the worksheets included in the report. To add written text to the table of contents, right-click the tabs of the individual pages and select **Rename** from the context menu. As soon as you have finished the entry, DIAdem refreshes the text of the table of contents.

6

Automating Sequences

Use DIAdem SCRIPT to combine steps for recurring processes, such as standard calculations and serial evaluations in a script, in order to automate these processes. A script can use functions from all DIAdem panels. You start a script when DIAdem launches, or with a button in a dialog box, or with the **DIAdem Scripts** function group in any of the panels. You use control structures and dialog boxes to create a flexible script for different data sets, analysis methods, and report displays and equip the application with an individual interface.

Figure 6-1. DIAdem SCRIPT

Working with Scripts

The easiest way to create a script is in the recording mode. DIAdem records the commands for each interactive step you execute. You can edit, test, and extend the recorded script. To record a script, click the **Enable Recording Mode** button, on the DIAdem SCRIPT toolbar. Then generate the script by interactively loading data or layouts, or executing calculations. DIAdem SCRIPT records the actions as commands in the script editor. Use the shortcut <Ctrl-Shift-C>, to add the settings from an open dialog box to the recorded script. To end the recording, click **Disable Recording Mode**.

Editing Scripts

DIAdem displays the recorded script in a new worksheet in the script editor. Use functions such as CodeCompletion, bookmarks, restoring, and find and replace, to make script editing easier. The syntax coloring helps you to distinguish between comments, commands, and variables. You can also distinguish methods and objects with their properties. If you want to change the syntax colors or the tabulator width, select **Properties** from the context menu of the script editor. The status bar of the editor displays the current cursor position, the insert or overwrite mode, changes to the script, and a possible write protection.

If you position the cursor on a command, a variable, or the property of an object, the SmartInfo displays the parameters of the command and the property, or the value range of the variable followed by a short description. Click **Display Help on This Subject** in the SmartInfo to call the Help for the command, the variable, or the property directly. If you enter the first letter of a command, DIAdem completes the name or displays all commands, objects, and procedures that

start with this letter. If you enter the name of an object and complete the entry with a dot, the script editor offers the properties and methods that are available for this object.

The script editor contains keyboard shortcuts which make script editing easier. Use the shortcut <Ctrl-D> to comment selected script lines and use <Ctrl-Shift-D> to convert comment lines back to script statements. If you click next to an opening parenthesis, the script editor automatically highlights the respective closing parenthesis. Use the shortcut <Ctrl-B> to jump back and forth between the parentheses to check nested bracket terms.

Testing and Saving Scripts

To test the script that is visible in the script editor, click **Run Script** on the DIAdem SCRIPT toolbar. That way, you can test whether the script is running without errors and is executing the steps as expected.

If DIAdem does not execute the script correctly, use the script debugger to find errors in the script. As soon as an error occurs, the debugger displays a green marker in front of the incorrect script line. The error appears on the **Logfile** tab in the information area below the script. If you want to view only the current error messages on this tab, you must first select **Delete Logfile View** from the context menu. To monitor variables drag and drop a variable from the script into the watch window of the information area. If you set breakpoints in the script, DIAdem displays the contents of the variable.

Save the script for reuse. If you want to save several scripts open in the script editor, right-click the tab and select **Save All Files** from the context menu. To execute a script you saved, without loading it to the script editor, click **Run Script From File**. Assign frequently-used scripts to a button in the **DIAdem Scripts** function group. This function group is available in all the DIAdem panels, so you can start these scripts in each panel.

Figure 6-2. Script Function Groups Available in all Panels
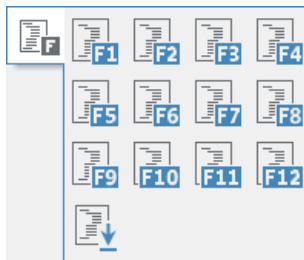
Note   You can also enter scripts in the DIAdem shortcut properties to start sequences automatically when DIAdem launches. Refer to section *Loading DIAdem Configurations* in this chapter, for information on automatically starting scripts.

You can save all files that you need for a project, as a workspace. To do so, load all files such as the different scripts, variable definition files, and list files of the project and select **File»Save Workspace As** to create a workspace. DIAdem saves workspaces with the filename extension `.wsp`. To automatically load all project files, select **File»Open Workspace** to load a workspace, or select **Settings»DIAdem Settings»SCRIPT** and specify a workspace as the default file.

You can encrypt scripts and User Dialog Boxes to use scripts on other computers without the user being able to modify the script or the user dialog box. To encrypt scripts and user dialog boxes, select **Script»Encrypt VBS Script/SUD File** and load the respective script or dialog box file. DIAdem saves encrypted scripts with the filename extension `.vbc` and encrypted user dialog boxes with the filename extension `.suc`. Refer to *Creating User Dialog Boxes* in this chapter for further information about user dialog boxes.

By default DIAdem saves scripts in Unicode. Unicode characters include Chinese, Japanese, and Arabic characters. Select **File»Change Coding** to save a script in ANSI format instead.

Creating Scripts

A script is a sequence of commands, formula calculations, and object definitions. You use loops and branches to control the script. You can use comments, empty lines, and indentation to give the script a clear structure.

Scripts are easier to read and to reuse if you keep to a few basic rules:

- Write only one statement in each line of the script.
- Use comments to describe the structure of the script and the commands you use. Start comments with a single quotation mark (') and include them at any point in your script.
- Insert an empty line to separate related statements.
- Indent the statements for branches and loops, so that the beginning and the end of a structure are in line and easier to identify. This is useful for nested structures. Use tabulators and select **Properties»Automatic Indent»Block** from the context menu of the script editor.
- Combine recurring statements or a group of related statements, in procedures. Procedures start and end with the keywords `Sub` and `End Sub`. To run a procedure, `Call` the procedure name.

Executing Commands

You can use the commands from all the DIAdem functions in scripts. The recording mode records the command for each function that you call in the interface, in the script editor. DIAdem also includes commands that you only can use in scripts, such as the SQL commands for communicating with databases.

You use `Call` to call a DIAdem command in a script. Enter the parameters, such as the channels to be used and the selection terms for the calculation procedure, in parentheses:

```
Call ChnPeakFind("[1]/Time","[1]/Speed",_
"Results/PeakX","Results/"&_
"PeakY",5,"Max.Peaks","Amplitude")
```

The peak search command searches for the five highest amplitude peaks in the curves defined by the channels `Time` and `Speed` and stores the results in the channels `PeakX` and `PeakY`. If you do not specify a channel group for the result channels, DIAdem creates the two new channels in the default group of the Data Portal.

Because channel names can occur multiple times in the Data Portal, we recommend that you specify the group index with the channel name, for example, `[2]/PeakX`. If the channel group does not always have the same number, enter the group name instead of the number, for example, `Results/PeakX`. A unique channel reference that consists of the group name and the channel name ensures that even with recurring channel names, the script returns correct results.

📝 **Note**   If the command parameters do not all fit into one line, use the `_` sign as shown in the first script line in order to generate a wordwrap in the parameter list of the command. Use the string `&_`, if the word-wrap occurs within a multi-line text as shown in the second script line.

To include one script in another script, use the command `ScriptInclude`. This command registers all global variables, procedures, and functions of the subscript and initializes the variables. Then you can access these variables, procedures, and functions in the main script. The following example calls the script `SubScript.vbs` and accesses the procedure `GetChnName` and the variable `StrChannelName` of the subscript. If you try to start the `Call SubScript.vbs` subscript directly, an error message informs you that you cannot execute a subscript.

```
Option Explicit
Call ScriptInclude("SubScript")
Call GetChnName(1)
Call MsgBoxDisp(StrChannelName)
```

Using Variables

Variables transfer parameters to commands, receive the results of mathematical calculations, or control scripts. Program variables have a specific purpose in DIAdem and are usually used for command parameters. You can name and use VBS variables in scripts as you wish. DIAdem provides auxiliary variables and user variables for special purposes.

Unlike DIAdem, VBScript does not provide predefined variables or data types. VBS variables are always a variant data type, which uses different data types depending on what you use the variable for. A VBS variable reacts like a number when you use the variable in a calculation, and a VBS variable reacts like a string when you assign text to the variable.

Declare VBS variables with the `Dim` statement. The following example contains the declaration for a numeric variable and a text variable. At the beginning of a script you can use the `Option Explicit` command to force the declaration of VBS variables. This prevents the VBS from automatically creating missing variables, which can lead to errors in the script and which are difficult to detect, when, for example, `MyVariable` is spelled with a typing error `MyVariablel`.

```
Option Explicit
Dim MyNumber, MyString
MyNumber = 12
MyString = "DIAdem"
```

Calculating Formulas

You can also use the formulas that you enter in the Calculator to calculate channels and single values in scripts. DIAdem records the formulas with the complete syntax in the recording mode. If you divide, for example, the `Input1` channel by the `Reference` channel from the first channel group and store the result in the new channel `Result`, DIAdem records the following command line in the script editor:

```
Call ChnCalculate("Ch(""[1]/Result"") = _
Ch(""[1]/Input"")/Ch(""[1]/Reference"")")
```

DIAdem calls the Calculator function `ChnCalculate` with `Call` and calculates the formula specified as the parameter. The individual channel assignments are set in double quotation marks because these parameters are also text. Refer to the *Calculating Formulas in the Calculator* section in Chapter 4, *Analyzing Data with Mathematical Functions*, for more information about the formula syntax.

Controlling the Script Sequence

When you record a script, DIAdem works through the script line by line. Insert loops, branches, and control commands to design a dynamic script.

Use loops to repeat statements. A loop repeats a group of statements until the loop counter reaches a specified value. You can configure a loop with a Do While...Loop statement or a For...Next statement. Use branches to execute different statements in relation to conditions. You can create a branch with an If...Then...Else statement or a Case separator. If `L1` is greater than zero, the following branch smoothes the `Speed` channel with a channel length that depends on the smoothing width:

```
If L1 <= 0 Then
 Call MsgBoxDisp("No Calculation")
Else
 SmoothWidth = trunc(ChnLength("[1]/Speed")/10)
 Call ChnSmooth("[1]/Speed", "Results/Smooth_Speed", SmoothWidth)
End If
```

Use the Exit statement to abort the execution of a loop or of a procedure and use the With statement to execute a series of statements on a singular object.

Use control commands to stop or to abort scripts. For example, the `KeyWait` command stops the script until the user presses a key, and the `Pause` command stops the script for a specific length of time.

Use the interaction mode to stop scripts and in order to work interactively with DIAdem. During interaction, you can, for example, specify in the script a curve section for evaluation in DIAdem VIEW. Use the `InterActionOn` command to enable the interaction mode in scripts. You can add a text to the command which DIAdem displays in a dialog box. To execute the actions, move the dialog box on the screen. To end the interaction, click the dialog box. If you do not add a text to the command, click the **End Interaction** button on the toolbar of any panel to end the interaction mode.

Creating User Interfaces

You can link scripts to dialog boxes in order to select calculation methods, to request entries, or to load files. To configure a standard mathematical function before the calculation, call the appropriate DIAdem program dialog box in the script. Use the DIAdem SCRIPT dialog editor to create project-specific user dialog boxes for making entries and requests.

Calling Program Dialog Boxes

Program dialog boxes are standard DIAdem dialog boxes that you use in your script to, for example, configure standard mathematical functions or to execute file operations. Click **Help** in the dialog box and refer to the **Script Call** on the DIAdem Help page, for the complete name of the program dialog box. To select the characteristic values of the descriptive statistics, use the following script line:

```
Call SUDDlgShow("Main", ResourceDrv & _
"AnaChnStatisticsChannel_BlockCalc")
```

When the script calls the dialog box, you select the characteristic values and click **OK**. DIAdem calculates the characteristic values, transfers the results to the associated program variables, and continues to execute the script.

Use the `FileDlgShow` command to open the default dialog box for loading and saving files. To load data files, add the following lines to the script:

```
Dim iCount
Call FileDlgShow(DataReadPath, "TDM Files (*.tdm),*.tdm | TDMS Files
(*.tdms),*.tdms", "Data selection", True)
If (DlgState = "IDOk") Then
 For iCount = 0 To Ubound(FileDlgNameList)
  Call DataFileLoad(FileDlgNameList(iCount))
 Next
Else
 Call MsgBoxDisp("Data loading was cancelled")
End If
```

The `FileDlgShow` opens the folder that contains the data files and offers the TDM and TDMS file formats for selection. The dialog box name is **`Data Selection`**. Because the last parameter `FileDlgMultiSelect=True` enables the selection of several files, DIAdem writes the names of all the files selected in the dialog box into the variable `FileDlgNameList`. If you close the dialog box with **OK**, the `DataFileLoad` command loads the files specified in `FileDlgNameList` into the Data Portal.

Creating User Dialog Boxes

You create user dialog boxes to enter values, to request settings, or to start functions. Use the DIAdem SCRIPT dialog editor to create dialog boxes, which you save in a dialog box file with the filename extension `.sud`. You call user dialog boxes in the script with the `SudDlgShow` command. Include the dialog box name and the dialog box file. The call that opens the user dialog box shown in the following figure is:

```
Call SudDlgShow("DlgEvalMain",ProgramDrv & _
"Examples\Documents\Crash_MMEEvaluation.sud")
```

Figure 6-3. User Interface for a Crash Evaluation
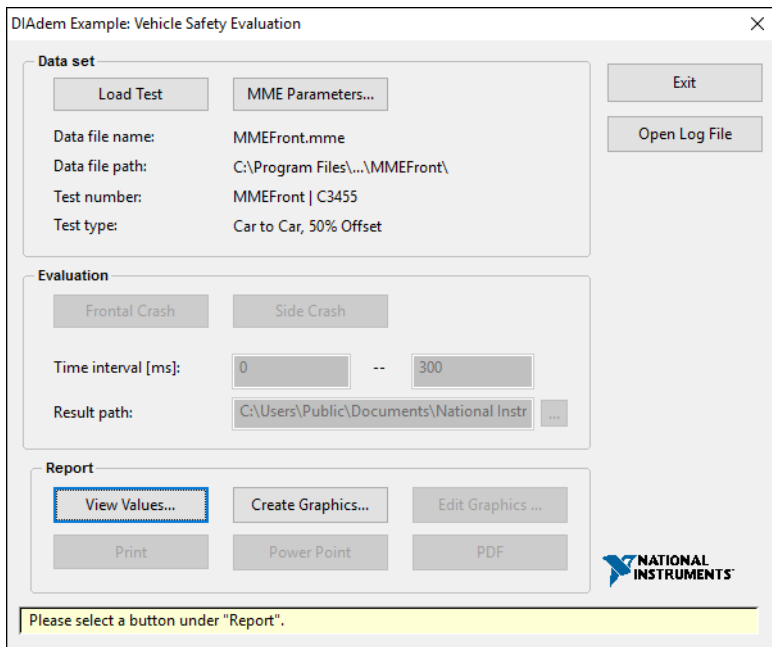
You can use events to connect the elements in the user dialog box with logical operations. The figure above shows the main dialog box for a crash evaluation, in which DIAdem enables the buttons one at a time after the appropriate steps. In the first step you load the test data and specify whether you want to examine a frontal impact or a side impact. In the second step you evaluate the selected data set. In the third step you select the display mode for the results.

The dialog box file for this crash evaluation contains several dialog boxes. If you click the **View Values** button, the script opens the dialog box DlgResults to display the calculated injury criteria for the evaluated test.

Usually you close a dialog box to transfer the entries to the script and to continue the evaluation. These are *modal* dialog boxes, which you open with the SudDlgShow command. DIAdem does not continue the script until the user closes the dialog box. You can open user dialog boxes in non-modal mode to obtain permanent user interfaces for extensive evaluations in order to control the application. Use the SudDlgCreate command to open the dialog box in non-modal mode.

Defining User Dialog Boxes

To create user dialog boxes, call the dialog editor on the DIAdem SCRIPT toolbar or use the templates in the **Dialog Box Templates** function group. If you need a user dialog box for channel selection, click the **Dialog Box Template for Channel Selection**. Enter a name for the dialog box definition, for example, MyDialog.sud. DIAdem loads the template into the dialog editor.

Figure 6-4. Dialog Box Templates

The dialog box template for selecting channels contains two selection fields, a Cancel button, and an OK button. In the dialog editor you can add other controls such as checkboxes, radio buttons, selection lists, spin boxes, tables, or ActiveX objects. Use frames, text, and graphics to design your dialog box. You can resize and reposition the controls and align them in relation to each other. To use a dialog box in DIAdem VIEW, you must add the **VIEWConnector** somewhere in the dialog box. The VIEWConnector is an invisible control with which the various areas in DIAdem VIEW communicate.

If you want to include many input options in a dialog box, you can use the **TabPageCtrl** control to create a multipage dialog box. Group the input options on several tabs according to a subject. The dialog box for the curve and axis definition of a 2D axis system in DIAdem REPORT has such tabs.

Use the **Tree** control to list elements hierarchically in a tree and to open branches with a click on a tree node. Use the **XTable** control to assign controls such as buttons, checkboxes, ComboBoxes, ListBoxes, or EditBoxes to each column of the extended table. To control the contents of the extended table and of the tree, you use events because they make a dynamic display possible.

Every control has properties which you can change in the properties display of the dialog editor. The properties are, for example, Color, Font, Title, or ToolTipText. The tabulator order specifies the order in which controls are enabled when you use the <Tab> control to navigate the dialog box.

Controlling User Dialog Boxes

You can control user dialog boxes with events. For example, you cannot enable the **OK** button before the user enters values. The available events of a control are in the properties display on a separate tab. You must specify appropriate commands for the procedures which the event calls.

Select an event on the **Events** tab in the first column of the properties display. To define this event procedure, click the button with the three dots and open the editor which defines this event. Click the **Script View** button to return to the dialog box view.

The `EventClick` event is linked to a button click. The `Enable` method activates a control. To enable the **CalculateButton** by clicking the **LoadButton**, use the following script:

```
Sub LoadButton_EventClick(ByRef This)
 CalculateButton.Enable = 1
End Sub
```

Saving and Testing User Dialog Boxes

To check the appearance of the dialog box, select **View»Preview**. To test the dialog box functions, select **View»Test in DIAdem**. This function checks the variable definitions and the event definitions of each control.

After designing and testing a dialog box, you save the user dialog box in a dialog box file with the filename extension `.sud`. In a dialog box file, you can save several dialog boxes, so that all the dialog boxes of a project are in the same SUD file. To add a dialog box to a dialog box file, select **Dialog Box»New**. To copy and to delete dialog boxes, select **Dialog Box»Dialog Box Overview**.

You can save parts of the user dialog box in the catalog window in the dialog editor. Select **View»Catalog** to open the catalog. Select the dialog box controls that you want to save and select **Copy** from the context menu. Then click the catalog window and select **Paste** from the context menu to copy the selected controls from the clipboard to the catalog. You save the properties and events together with the controls. You can save catalogs in a CAT file, create new catalogs, and load catalogs.

Object Oriented Script Interfaces

DIAdem SCRIPT provides various object-oriented interfaces which you can use in scripts in order to access DIAdem functions. Object-oriented programming interfaces define objects, sub-objects, and collections of single objects. Use methods to create (`Add`) or to delete (`Remove`) objects and use properties to change these objects.

You can only access certain objects such as VIEW and REPORT with a script if the respective panel was already opened once before. To open a panel, use the WndOpen command with the panel name.

DIAdem NAVIGATOR

In DIAdem NAVIGATOR you can use several objects to access external data stores, search results, browser views, internal data, or Bus logfiles.

Finding and Loading External Data

Use the Navigator object to open external data stores, to mine data, and to load and to select the data you find in the search results and in the file browser. Subobjects of the Navigator object are external data stores, DataFinders, queries, search results, and browser views.

The following example executes an advanced search for channel groups with the name Weather. The script enters the parameters for the query in the DIAdem NAVIGATOR interface and lists the channels of the located channel groups, on the **Search Results** tab.

```
Dim oMyAdvancedQuery
Set oMyAdvancedQuery = Navigator.CreateQuery(eAdvancedQuery)
Call oMyAdvancedQuery.Conditions._
Add (eSearchChannelGroup,"name", "=", "weather")
oMyAdvancedQuery.ReturnType = eSearchChannel
Call Navigator.Display.CurrDataFinder.QueryForm._
SetCurrQuery(oMyAdvancedQuery)
Call Navigator.Display.CurrDataFinder.QueryForm.Search()
Call WndShow("NAVIGATOR","Open")
```

The following example searches in an ASAM data store. DIAdem opens the data store ASAM Browse Settings Example and searches for all measurements with the name Torque. The script enters the parameters for the query in the DIAdem NAVIGATOR interface and lists the channels of the located measurements, on the **Search Results** tab.

```
Dim oMyStoreQuery
Call Navigator.Display.OpenDataStore("ASAM Browse Settings Example")
Set oMyStoreQuery = Navigator._
ConnectDataStore("ASAM Browse Settings Example").CreateQuery()
Call oMyStoreQuery.Conditions._
Add("MeaQuantity","Name","=","Torque")
oMyStoreQuery.Conditions.Logic = "C1"
oMyStoreQuery.ReturnType = "Measurement"
Call Navigator.Display.CurrDataStore.QueryForm._
SetCurrQuery(oMyStoreQuery)
Call Navigator.Display.CurrDataStore.QueryForm.Search()
```

To execute a quick search in a script, enter the search term in DIAdem NAVIGATOR in the recording mode and press <Ctrl-Shift-C>. In the script editor you see the commands with the

object names and the variable assignments for a search with or without the DIAdem NAVIGATOR interface.

Changing the Data Portal View

Use the `Portal` object to specify the view of the Data Portal, to display channel groups, and to select channels. The Data Portal can be fixed at the right edge or can be moved on the screen. The structure view and the list view of the Data Portal are subobjects of the Portal object.

The following example enables the structure view of the Data Portal and downsizes the properties window to 40 percent of the height of the Data Portal. After deleting all selections, the script opens the first channel group and selects the third channel in this channel group.

```
Portal.Visible = TRUE
Call Portal.Structure.Activate
Portal.Ratio = 60
Call Portal.Structure.Selection.RemoveAll
Call Portal.Structure.Expand(Data.Root.ChannelGroups(1))
Call Portal.Structure.Selection._
Add(Data.Root.ChannelGroups(1).Channels(3))
```

Editing Internal Data

Use the `Data` object to edit, to delete, or to recreate data loaded in the Data Portal. You can access internal data and the properties of the internal data in scripts. You can also change the template for the custom properties or create a new template. Data sets, channel groups, channels, data elements, properties, and the templates for custom properties are subobjects of the Data object.

The following example first deletes all data loaded into the Data Portal and then creates the channel group `MyChnGroup` with the channel `MyChannel`:

```
Dim oMyGrp, oMyChn
Call Data.Root.ChannelGroups.RemoveAll
Set oMyGrp = Data.Root.ChannelGroups.Add("MyChnGroup")
Call oMyGrp.Channels.Add("MyChannel",DataTypeFloat64)
```

Use the subobject `CustomPropertyTemplate` to access the template of the custom properties. The following example line displays a message as to whether a template for the custom properties has been created:

```
Call MsgBoxDisp(Data.Settings.CustomPropertyTemplate.Active)
```

Creating DataPlugins

Use the DataPlugin object to load, register, and search for additional file formats in DIAdem. DataPlugins describe file formats so that DIAdem can read the associated data files through the USI (Universal Storage Interface) interface. The Root object, the File object, the Store object, and the Workbook object are subobjects of the DataPlugin object. The Root object provides the collection of all channel groups and of all properties of a data file. The File object specifies the

structure of text files and binary files. The Store object describes the transfer of a data model into the TDM data model. The Workbook object supports the reading of files from table calculations.

The DataPlugin Wizard that you can open in DIAdem NAVIGATOR analyzes data files, creates instances of the data model `Root`, `ChannelGroups`, and `Channels`, and fills these instances with the information that has been read. Finally, the wizard registers this script as a DataPlugin in DIAdem. The `ni.com/dataplugins` website offers DataPlugins for various file formats created and tested by DIAdem programmers and by DIAdem users. In this user portal you can make the DataPlugins you create accessible to other DIAdem users.

The following example reads in the values of the first page of a spreadsheet columnwise from the second row of the first column and saves the values in channels of the first channel group:

```
Call Root.Properties.Add("Title",Workbook.WorkbookInfo.Title)
Call Root.Properties.Add("Author",Workbook.WorkbookInfo.Author)
Dim oCurrSheet
Set oCurrSheet = Workbook.Sheets(1)
Dim oCellBlock
Set oCellBlock = oCurrSheet.GetCellBlock(2,1)
Dim i, Name, oNewChannel
For i = 1 to oCurrSheet.MaxPosition.Column
 Name = oCurrSheet.GetCellValue(1,i)
 Set oNewChannel = oCellBlock.Channels.Add(Name)
 Call Root.ChannelGroups(1).Channels._
AddDirectAccessChannel(oNewChannel)
Next
```

Converting Bus Logfiles

Use the `BusLogToTDM` object to convert bus log files from CAN, LIN, and FlexRay bus systems into the TDM file format. To do so, enter the logfile you want to convert, the database file you want to interpret, and a TCC file with the Bus Log Converter configuration. You can also edit database files, add and delete buses, and specify clusters or XNET channels. The following example reads in the logfile `XNET_File2.tdms` with the database file `XNET_TDMS.xml` and saves the converted data packages in the TDM file `XNET_File2.tdm`.

```
Call BusLogToTDM.Clear()
BusLogToTDM.LogSettings.FileType = eLogFileTypeTdms
Call BusLogToTDM.LogSettings.LogFiles.Add("D:\XNET_File2.tdms")
BusLogToTDM.BusDbConfig.Name = "TDMSExample"
Call BusLogToTDM.BusDbConfig.Buses.Add("CANBus",0)
Dim oDbFile
Set oDbFile = BusLogToTDM.BusDbConfig.Buses("CANBus").DbFiles._
Add("D:\XNET_TDMS.xml")
oDbFile.IdMode = eDbFileIdModeDefault
Call oDbFile.Clusters.Add("HighBusLoad")
BusLogToTDM.ResultSettings.ResultFile = "D:\XNET_File2.tdm"
BusLogToTDM.ResultSettings.EnumSubstitution = True
BusLogToTDM.ResultSettings.SequenceChannel = False
```

```
BusLogToTDM.ResultSettings.TimeFilter.Active = False
BusLogToTDM.ResultSettings.BusFilter.Active = False
Call BusLogToTDM.Convert()
```

DIAdem ANALYSIS

Use the objects `CalculationSet`, `UnitCatalog`, and `LVRuntime` to load and to execute a calculation template, a unit set, or LabVIEW VI.

Calculation Templates

Use the `CalculationSet` object to load calculation sets, to validate individual calculation groups, and to execute the corresponding calculations. The DIAdem calculation manager differentiates between calculation sets, calculation groups, calculations, inputs, and outputs.

The following example loads the calculation set `CalculationSet_Example.TCA`, checks the calculations in the group `Noise pressure level`, and starts the calculation.

```
Dim oCalc
Call CalculationSet.Load(sPathDocuments &
"CalculationSet_Example.TCA")
Set oCalc = CalculationSet.CalculationGroups("Noise
calculations").Calculations("Noise pressure level")
 If oCalc.Validate Then
 Call oCalc.Run
Else
 Call MsgBoxDisp("The calculation can't be executed.")
End if
```

Units Catalog

Use the `UnitCatalog` object to load unit sets and to add, to edit, and to delete physical quantities and symbols to a unit set. The units catalog in DIAdem consists of unit sets, physical quantities, units, and the associated unit symbols.

If the unit set `Basis` is available, the following example generates the new unit `Velocity`, including the symbol. If this unit set is not available in DIAdem, the script calls the input dialog box of the units catalog.

```
If UnitCatalog.Sets.Exists("Basis") Then
  Call UnitCatalog.Quantities.Add("Velocity",1,0,-1,0,0,0,0)
  Call UnitCatalog.Quantities("Velocity").Units.Add("meter per"
"second","m*s^-1",1,0,"linear")
  Call UnitCatalog.Sets("Basis").UsedQuantities.Add("Velocity")
Else
  Call UnitCatalog.ShowSettingsDlg
End If
```

LabVIEW VIs

Use the `LVRuntime` object to call LabVIEW VIs in DIAdem, to transfer values to VIs, to execute VIs, and to call events and to display them in DIAdem REPORT.

The following script calls the LabVIEW Runtime Engine, loads the LabVIEW VI `Test.vi`, and sets the input `Input1`. At the end, the script disconnects LabVIEW.

```
Dim sgRunTimeVersionT : sgRunTimeVersionT = ""
Call LVRuntime.Init(sgRunTimeVersionT)
Dim objVI
Set objVI = LVRuntime.LoadVI(AutoActPath & "Test")
Call objVI.SetControlValue("Input1","InputValue")
Call objVI.Run(true)
Set objVI = Nothing
Call LVRuntime.DeInit
```

To call a LabVIEW VI in DIAdem using the LVRuntime interface, LabVIEW does not need to be installed on your computer. The DIAdem installation includes the LabVIEW runtime engine, which you use to execute VIs. However, to create a VI you must install LabVIEW.

DIAdem VIEW

Use the `View` object to create, edit, or to delete worksheets, areas, axis systems, channel tables, videos, 3D models, maps, contours, or dialog boxes in DIAdem VIEW.

The following example deletes all the worksheets in DIAdem VIEW and generates the new worksheet `MySheet`. In the new worksheet, the script defines a 2D axis system for the `NewArea`, and creates a curve in the axis system with `Time` as the x-channel and `Speed` as the y-channel.

```
Dim oMySheet, oNewArea
Call View.Sheets.RemoveAll()
Set oMySheet = View.Sheets.Add("NewSheet")
Set oNewArea = oMySheet.ActiveArea
oNewArea.DisplayObjType = "CurveChart2D"
Call oNewArea.DisplayObj.Curves.Add("[1]/Time","[1]/Speed")
Call WndOpen("VIEW")
```

DIAdem REPORT

Use the `Report` object to create, edit, or to delete worksheets, 2D axis systems, 3D axis systems, polar axis systems, 2D and 3D tables, text and formulas, lines and comments, circles and rectangles, settings, and master layouts in DIAdem REPORT. You can also use the Report object to change the general properties of DIAdem REPORT.

The following example generates a 2D axis system which displays speed over time as a curve.

```
Dim oMy2DAxisSystem, oMyPos, oMy2DCurve
Call Report.NewLayout()
```

```
Set oMy2DAxisSystem = Report.ActiveSheet.Objects._
Add(eReportObject2DAxisSystem,"My2DAxisSystem")
Set oMyPos = oMy2DAxisSystem.Position.ByCoordinate
oMyPos.X1 = 20
oMyPos.X2 = 80
oMyPos.Y1 = 20
oMyPos.Y2 = 80
Set oMy2DCurve =
oMy2DAxisSystem.Curves2D.Add(e2DShapeLine,"MyNew2DCurve")
oMy2DCurve.Shape.XChannel.Reference = "[1]/Time"
oMy2DCurve.Shape.YChannel.Reference = "[1]/Speed"
Call Report.Refresh()
```

As in other DIAdem panels you can use the shortcut <Ctrl-Shift-C> in DIAdem REPORT to copy the settings of an open dialog box, including the object hierarchy, to the clipboard or to add them to the script in the recording mode. If you use this function in the **Curve and Axis Definition** dialog box in an axis system, you add all objects used in the open dialog box including their properties, methods, and current values to the script. To limit the recorded script lines to the essential parts, select, for example, a curve in the worksheet before you press <Ctrl-Shift-C>. When you change to DIAdem SCRIPT, you only copy the basic definition of this curve into the script editor with <Ctrl-V>.

Assigning Properties to Documents and Graphics

Use the `Document <Data>` object to read, to set, or to add properties of office files in XML format and of PDF documents or graphics in JPEG-, PNG-, and TIFF format. Every document and every graphic contains base properties such as filename, description, title, author, and storage date. Create a custom property such as `TestSequence` in the layout parameters of a report. When you export the report, the PDF file or the graphic contains the name of the test series.

You can read a base property and change the value. You can read a custom property and change the value, and you can use a script to create and to delete a custom property. To do so, use the `OpenDocument` command to open a PDF document or a graphic. The following example reads the names and the values of the properties of a PDF document and displays them in a message.

```
Dim oMyDocument, oMyProperty, sOut
Set oMyDocument = OpenDocument(ProgramDrv &
"Manuals\DIAdem_GettingStarted.pdf", True, eDocumentTypeAuto)
For each oMyProperty in oMyDocument.Properties
  sOut = sOut & "Name: " & oMyProperty.Name & ", Value: " &
oMyProperty.Value & VBCrLf
Next
Call MsgBox(sOut)
```

Extended Program Interface

DIAdem provides various objects for adding functions to function groups, toolbars, menus, and context menus, or for the configuration of user dialog boxes.

Function Groups and Toolbars

Use the `BarManager` object to change menus, toolbars, and function groups, or to create new menus and function groups. You can create, copy, and delete buttons and menu entries. Use `Reset` to restore the delivery status.

The following example creates the new function group **My Function Bar** with the button **My Function** in the group bar in DIAdem SCRIPT. Then the script saves the bar definition `MyBarManager`.

```
Call BarManager.Reset()
Dim oMyFct, oMyFctBar, oMyFctBarPopup, oMyBar
Set oMyFct = BarManager.ActionObjs.Add("MyFct","CustomButton")
oMyFct.ToolTip = "My function"
oMyFct.OnClickCode.Code = "Call MsgBoxDisp(""My new function"")"
Set oMyFctBar = BarManager.Bars.Add("MyFctBar")
Call oMyFctBar.UsedActionObjs.Add(oMyFct)
Set oMyFctBarPopup = BarManager.ActionObjs._
Add("MyFctPopup","CustomPopup")
oMyFctBarPopup.ToolTip = "My function bar"
oMyFctBarPopup.BarID = oMyFctBar.ID
BarManager.Bars("SCRGroup").UsedActionObjs.Add(oMyFctBarPopup)
Call BarManager.Save("MyBarManager.bdn")
```

DIAdem saves bar definitions with the filename extension `.bdn` in the folder that contains the local settings, for example, in the desktop file `desktop.ddd`. To assign a new symbol to the new function, create an ICO file with several pictures sized 16, 24, 32, and 48 pixels, and save this file in the respective subfolder `MyBarManager`.

The following example creates the menu **Testing** with the submenu **TestingProject** DIAdem ANALYSIS. The functions **Run** and **Edit** of the submenu are prepared in this script but not yet defined.

```
Dim ProjectPath: ProjectPath = CommonDocumentsPath & "Documents\"
const ProjectFile = "CalculateTests"
const ProjectName = "Testing Project"
function CreateTestingMenu(sgID, sgCaption, oParentBar)
' Create ActionObject for menu bar ---------
dim oActObj
if (BarManager.ActionObjs.Exists(sgID)) then
  set oActObj = BarManager.ActionObjs(sgID)
else
  set oActObj = BarManager.ActionObjs.Add(sgID, "CustomPopup")
  oActObj.BarID = sgID
```

```
  oActObj.Caption = sgCaption
end if
if not (oParentBar.UsedActionObjs.Exists(sgID)) then
  call oParentBar.UsedActionObjs.Add(sgID)
end if

' Create menu bar --------------------
dim oBar
if (BarManager.Bars.Exists(sgID)) then
  set oBar = BarManager.Bars(sgID)
else
  set oBar = BarManager.Bars.Add(sgID)
  oBar.Style = eBarStyleIconCaption
  oBar.ActionObjPictureWidth = 16
  oBar.ActionObjPictureHeight = 16
end if
set CreateTestingMenu = oBar
end function

'Create menu items --------------------
function CreateProjectMenuItem(sgID, sgCaption, oBar)
dim oActObj
if (BarManager.ActionObjs.Exists(sgID)) then
  set oActObj = BarManager.ActionObjs(sgID)
else
  set oActObj = BarManager.ActionObjs.Add(sgID, "CustomButton")
  oActObj.Caption = sgCaption
end if
if (not oBar.UsedActionObjs.Exists(oActObj)) then
  call oBar.UsedActionObjs.Add(oActObj)
end if
set CreateProjectMenuItem = oActObj
end function

'Main --------------------
dim oMenuItem, oTestingBar, oProjectBar
set oTestingBar = CreateTestingMenu("MyTestingMenu",_
"Testing", BarManager.Bars("ANAMenuMain"))
set oProjectBar = CreateTestingMenu("MyTestingProject1Menu",_
ProjectName, oTestingBar)
set oMenuItem = CreateProjectMenuItem(ProjectName & "Run",_
"Run", oProjectBar)
oMenuItem.OnClickCode.Code = "call GetTesting._
RunTesting(""" & ProjectPath & """,""" & ProjectFile & """)"
set oMenuItem = CreateProjectMenuItem(ProjectName & "Edit",_
"Edit", oProjectBar)
oMenuItem.OnClickCode.Code = "call GetTesting._
EditTesting(""" & ProjectPath & """,""" & ProjectFile & """)"
```

Use the `Call BarManager.Reset()` command to reset all menus and bar definitions to the delivery status. This command deletes all user-defined menu entries and all buttons in the bar definition.

Context Menus

Use the context menu object to access context menus in DIAdem NAVIGATOR, in DIAdem VIEW, or in the SUD editor. Use the context menu object to create, delete, or to change entries in the context menu or in submenus. Use the context menu object in a user command which DIAdem executes when calling the context menu or when selecting a context menu entry.

The following example executes the user command `MyViewOnShowingContextMenu` when opening a context menu in DIAdem VIEW. This user command adds the menu entry **My Menu Point** to the context menu when you open the context menu of the channel table or of the axis system. When you click a context menu entry, the example executes the user command `MyViewOnContextMenuPointSelected` and displays the selected entry in a message.

```
Call AddUserCommandToEvent("View.Events.OnShowingContextMenu",_
"MyViewOnShowingContextMenu")
Call
AddUserCommandToEvent("View.Events.OnContextMenuPointSelected",_
"MyViewOnContextMenuPointSelected")

Sub MyViewOnShowingContextMenu(Area,MenuPoints)
 If (Area.DisplayObjType = "CurveChart2D") Then
  Call MenuPoints.Add("My CurveChart Menu Point",1)
 End If
 If (Area.DisplayObjType = "ChannelTable") Then
  Call MenuPoints.Add("My ChannelTable Menu Point",2)
 End If
End Sub

Sub MyViewOnContextMenuPointSelected(Area, MenuPoint)
 Select Case MenuPoint.ID
  Case 1 Call MsgBoxDisp("DIAdem-VIEW: MyMenuPoint1 selected")
  Case 2 Call MsgBoxDisp("DIAdem-VIEW: MyMenuPoint2 selected")
 End Select
End Sub
```

User Dialog Boxes

DIAdem provides an object-oriented script interface for user dialog boxes with which you access a dialog box. You can execute every user dialog box in modal or non-modal mode. In the modal mode, the script stops until the dialog box has closed. Therefore, you can only access the dialog box through the script interface in non-modal mode. First, use the `SudDlgCreate` command, the dialog box name, and the dialog box file to create a dialog box object. During the remainder of the script, you must ensure that DIAdem displays the non-modal dialog box. To do so, use the

`Show` method, which provides the Dialog object. Use the `Hide` method to hide the user dialog box. Use the methods `OK` and `Cancel` to close the user dialog box with the script.

```
Dim MyDlg
Set MyDlg = SudDlgCreate("Input","Example")
Call MyDlg.Show
 'further instructions
Call MyDlg.Ok
```

Within a script you can access the properties and methods of the non-modal user dialog box and also the properties and methods of the controls defined in the dialog box. Use the `GetControl` method to access a specific control of the dialog box through its object code. This way you can change control properties and also, for example, trigger a mouse click on a button.

The following example changes the color of a text and clicks a button.

```
Dim oText, oButton
oText = MyDlg.GetControl("Text1")
oText.ForeColor = vbRed
'further instructions'
oButton = MyDlg.GetControl("Button1")
Call oButton.RunClick
```

Special Functions

DIAdem SCRIPT provides special functions which you can use in DIAdem:

*   Specifying user-defined functions as user commands
*   Running serial evaluations
*   Loading DIAdem Configurations

Defining User Commands

You can define user commands in scripts to increase the amount of DIAdem commands. You can use user commands in Calculator formulas, for example, or in DIAdem REPORT and in DIAdem SCRIPT.

If you need a special format for data display in DIAdem REPORT, write a user command with the appropriate statements. The following figure shows in the right column a trend display with plus and minus signs for the values in the middle column. The definition of the right column has the user command `TabTrend` instead of a format definition:

`@@TabTrend(CFV)@@`

DIAdem recognizes user commands as variables by the leading and trailing `@@` characters. The `CFV` (short for `CurrentFormatValue`) variable stands for the current channel value.

Figure 6-5. Table with Trend Display Created by a User Command

Date	Value	Trend
2001/01/01	0.000	Start
2001/02/01	270.000	+++
2001/03/01	–43.000	-
2001/04/01	72.000	++
2001/05/01	–43.000	-
2001/06/01	124.000	+++
2001/07/01	–92.000	--
2001/08/01	10.000	+
2001/09/01	166.000	+++
2001/10/01	–42.000	-
2001/11/01	59.000	++
2001/12/01	45.000	+

You can define user commands as procedures or functions. Specify the user command
`TabTrend` for a trend display as a function because `TabTrend` must return a result value.
`TabTrend` shows a maximum of three plus signs or minus signs as text.

```
Function TabTrend(ByVal Value)
 If Value <= -100 Then
  TabTrend = "---"
 ElseIf (Value > -100) and (Value <= -50) Then
  .......
 ElseIf (Value >= 100) Then
  TabTrend = "+++"
 End If
End Function
```

For DIAdem to add the user commands to the collection of commands, you must select
Settings»Extensions»User Commands and register script files that contain user commands.
The user command `TabTrend` is in the `UserCmdReport.vbs` script in the example folder.
DIAdem saves the link to the script file in the desktop file. The user commands are then
permanent, until you delete the link or load another desktop file.

Evaluating a Series of Files

You can use DIAdem SCRIPT to automatically evaluate a series of similar files in a script,
without having to load each file separately. For example, if you run a long-term test that saves a
result file every day, you can evaluate all the files that are recorded in one week, at the beginning
of the following week. To do so, you define a statement for loading several data files and create
a loop statement with commands which you want to use for every file.

The following script opens the file selection dialog box where you can select several TDM files, for example, `Demo1.tdm`, `Demo2.tdm`, and `Demo3.tdm`. DIAdem writes the filenames into the variable `FileDlgNameList` to load, save, and smooth these files one after the other, and to then save the files under the new name `Series` with a running index.

```
Option Explicit
Dim i
If FileDlgShow(DataReadPath,"TDM Files,*.tdm",_
"DataSelection",True) = "IDOk" Then
 For i = 0 to UBound(FileDlgNameList)
  Call Data.Root.Clear()
  Call DataFileLoad(FileDlgNameList(i),"TDM","Load")
  Call ChnSmooth("[1]/[2]","/Smoothed",12,"maxNumber")
  Call DataFileSave("Series_"&str(i),"TDM")
 Next
End If
```

Loading DIAdem Configurations

You can configure DIAdem individually for different users and for different projects. Save the settings in different desktop files with **Settings»Save As**. If you want to use a configuration on a different computer, copy all configuration files (`.ddd`, `.par`, `.tuc`, `.bdn`) and the sub-folder, which has the same name as the desktop file, to the folder with the local settings on the target computer. To start DIAdem with a user-specific or project-specific configuration, call DIAdem with the parameter `/D` and the respective desktop file `MyProject.ddd`:

```
"diadem.exe" "/DC:\diadem\myproject"
```

In the properties for calling DIAdem, you can also use the parameter `/C` in order to execute a command or a script directly after DIAdem launches. Use the `/S` parameter to specify the local system folder to the DIAdem client, in a network installation. In a request you can combine these parameters with each other and use the `/C` parameter several times.

Development Environment for TDM Server

With DIAdem's development environment, configurations for the processing and evaluation of data with **TDM Server** can be developed, tested, loaded, and edited. TDM Server offers the possibility to outsource data and evaluations to a server and to organize them there centrally. TDM Server returns result data in TDM and TDMS format as well as reports as PDF documents and graphics. The result data and the related documents and graphics are marked with the same custom properties, such as the name of the test series, in order to find all files of a certain test series with DataFinder.

TDM Server contains DataFinder, Data Preprocessor, and Analysis Server. DataFinder indexes data in the specified search areas. Data Preprocessor standardizes the data of different measurements. Analysis Server executes calculations and creates reports.

Figure 6-6. TDM Server with Data Preprocessor, DataFinder, and Analysis Server
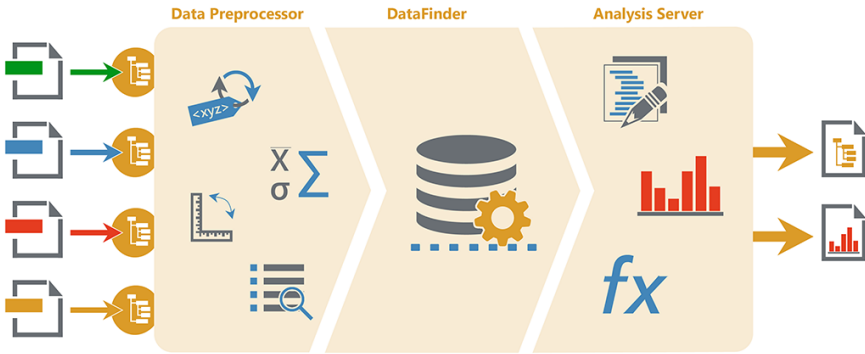
In DIAdem you can create configurations for Data Preprocessor and Analysis Server, and edit model hierarchies for DataFinder. The Analysis Server configurations contain the names of the implemented scripts and layouts which DIAdem bundles together with the configuration to a package. Copy the configuration packages to TDM Server and specify the automatic execution of evaluations there. In order to view the reports promptly, a success message is sent as an email.

Creating Data Preprocessor Configurations

Use Data Preprocessor to prepare measurement data from different sources for the analysis. For example, if you want to compare test stand results executed at different locations with the same test but with different hardware. In DIAdem **Settings»TDM Server»Data Preprocessor**, you edit and create Data Preprocessor configurations.

The dialog box displays all process chain steps available for data preparation. By default, no step is enabled or predefined. Select each step with a click on the symbol in the process chain. Then enable the step and configure the settings in the **Edit** dialog box. The selected steps in the process chain appear dark, whereas non-selected steps are dimmed. This way you can see directly which process steps have already been configured.

Figure 6-7. Process Chain in the Configuration Dialog Box for Data Preprocessor

Use the **Replace Identifier** and **Replace Value** steps to change the identifier and the value of a property. The same sensor might, for example, be stored in the Detector property with the value TC and in the probe property with the value 7241. In order to assign the data to the same sensor, both properties are replaced by Sensor with the value TC 7241.

Use the **Convert Units** step to convert measurement data into the same unit. For example, if temperatures were measured in `Fahrenheit °F` but are to be evaluated in `Celsius °C`, specify that temperatures are saved in `Celsius °C` in accordance with the units catalog.

Use the **Statistics** step to calculate characteristic statistical values, such as mean values, quantile, or dispersion values. Data Preprocessor saves the results as custom properties in the data files.

Use the **Validation & Verification** step to check whether the processed data is plausible and complete. The check can also include a request for limit values. If you click **Edit**, DIAdem copies a script template, which you have to complete for the data check, into the script editor.

Use the **Convert Data** step to specify, for example, `TDM` as the file format for the storage of predefined data. You also specify whether to overwrite or rename existing data.

Finally, save the Data Preprocessor configuration. DIAdem creates a package with the filename extension `DPP`. The dialog box contains functions to test and to debug this configuration. Specify a DataFinder as the data source on which DIAdem uses the configuration like in the TDM Server. DIAdem stores the result data in the Data Portal.

Creating Analysis Server Configurations

Use Analysis Server to execute calculations with the processed data and display the results in reports. Analysis Server saves the result data in new TDM files and exports the reports as PDF documents or graphics. Create and edit configurations for Analysis Server in DIAdem under **Settings»TDM Server»Analysis Server**.

Figure 6-8. Process Chain in the Configuration Dialog Box for Analysis Server

Use the **Search Request** step to define an Advanced Search. First, click **Data Filter Enabled** to show the search input area and the search results list. Create several search conditions for a search and connect the conditions with AND and OR. DIAdem automatically adds the search condition that only indexed data is included in the search. If, for example, you search for sensor data, select the property `Sensor` and enter the value `TC 7241`. As a second search condition, you can select a storage date, which should not be older than three months. If you search for channels, the search results list displays all channels the specified sensor measured during the previous 90 days. You can save search requests and use them in other configurations just as in DIAdem NAVIGATOR.

Use the **Parameter Definition** step to create exchange variables. In the exchange variables, you enter the settings for a function such as the window used for an FFT or the smoothing width. This way you can execute the same analysis with different parameters for similar measurement data, like in the analysis of a 4 cylinder and a 6 cylinder engine.

Use the **Analysis Script** step to combine the analysis package. The tree view in the lower part of the dialog box displays the files already in the work folder. If, for example, you saved a search in the **Search Request** step, you also see this TDQ file in the tree. Import files or whole folders with, for example, the layouts and logos and also additional scripts. All necessary files for the analysis procedure must be stored in the work folder and are displayed in the tree.

The tree always contains the script `Main.vbsa`. The filename extension `VBSA` shows that it is not a DIAdem script but the central script of an analysis configuration. Select this file in the tree and click **Edit**. DIAdem copies the main script to the script editor where you add evaluation functions, loading report layouts, and the result storage as TDM files, PDF documents and graphics to the script template.

Finally, save the Analysis Server configuration. DIAdem creates a package with the filename extension `ANP`. The dialog box contains functions to test and to debug this configuration. Specify a DataFinder as the data source like in the TDM Server. The result data is in the Data Portal and the PDF documents and graphics are in the work folder.

Extending DataFinder Hierarchies

Use DataFinders to find data on computers and servers in the network, in order to prepare them with Data Preprocessor and to evaluate them with Analysis Server. The data display in the file browser is based on the TDM model (file - group - channel) or the standard ASAM model (year - month, author - year - month). If, for example, you use data files of different models or you want to add file levels to the browser display, edit the DataFinder hierarchy.

You edit DataFinder hierarchies and create them in DIAdem in **Settings»TDM Server» DataFinder Hierarchy**. Click **New** to create a browser display and click **Open** to edit an existing one. You can create or delete data levels or import them through a reference file in the browser display.

Save your model hierarchy with the filename extension `DFH`. Copy this file to the TDM Server so that the model hierarchies are imported into the DataFinder. Refer to the section on *DataFinder Server* in Chapter 2, *Finding and Managing Data*, for more information about DataFinder.

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