DYNAST Documentation System

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DYNAST simulation package includes an integrated documentation system that can be used for documenting your simulation problems and submodels. It is based on easy-to-use WYSIWYG editor powered with extension for easy documentation of DYNAST files. The system can be also used for management of large collections of simulation problems and submodels. Documentation can be exported to PDF and HTML formats.

1 System Requirements

The DYNAST documentation system requires Java™ Runtime Environment (JRE) version 1.5 or higher. The JRE can be downloaded from http://www.java.com. If you want to import pictures in Encapsulated PostScript format, you should also install the GhostScript package from http://www.cs.wisc.edu/~ghost/. If you want to export your documentation to the Microsoft HTML Help format, you need to install the Microsoft HTML Help Workshop package.

2 Two Documentation Modes

The Dynast Documentation System currently supports two fundamentally different editing modes: the WYSIWYG mode (What You See Is What You Get), and the LaTeX-based mode.

3 Basic Components of the User Interface

To display the main frame of the documentation manager, invoke the Publishing → Documentation Manager command from Dynshell main window. The documentation manager window shows up, see Figure 1.
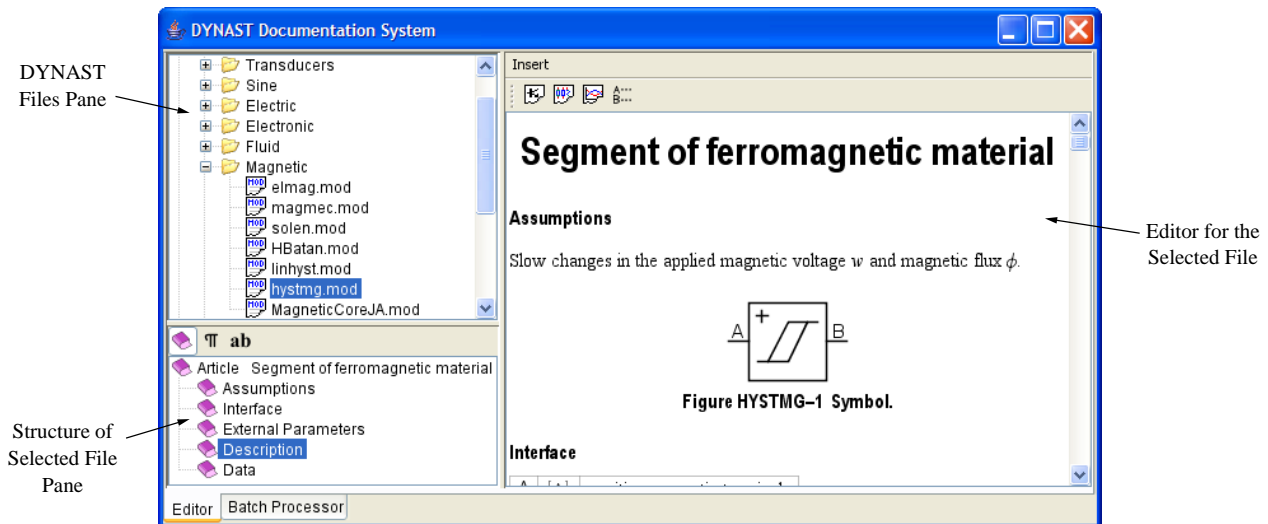

Figure 1 Documentation Manager Window

The upper-left part of the editor frame displays the DYNAST Files Pane. This pane actually displays contents of folders configured in Dynshell Folders configuration option. You may use this pane to browse the file structure, and to select a file for editing. The pane displays three kinds of items: folders denoted with the 📁 icon, DYNAST problem files denoted with the 📄 icon, and DYNAST submodel files denoted with 📄 icon. The 📁 icon denotes folder that does not contain any DYNAST files, and is thus irrelevant for the documentation system. The DYNAST Files Pane can be also used for managing collections of problems or submodels, see Section 4.

The lower-left part of the editor frame displays the structure of the file selected for editing. You may use this pane to navigate through the documentation of the selected file, or to drag and drop items in the pane to change the structure of the documentation.

The pane displayed in the right part of the frame displays documentation for the selected file, which can be interactively edited.

4 Managing File Collections

When you have completed authoring of documentation to individual files, you may want to publish documentation to whole collection of problem and submodel files. First, you need to define which files should be published and in which order, see Section 4.2. Second, you need to actually convert the documented files to any of the supported presentation formats, see Section 4.6.

4.1 Creating Files & Folders

To create new file or folder, select the parent folder in the Dynast Files Pane, and press the Insert key. You are prompted whether you want to create a File, a Folder, or a Logical folder (see Section 4.4).

4.2 Ordering and Disabling Items

The items that would appear in the collection are those files and folders displayed in the DYNAST Files pane. However, these objects are initially in some unspecified order in which they have been read from the disk. To change that order, just drag a file or folder, and drop it at desired location.

If you want to exclude some file or folder from the final presentation, right-click it with mouse, and select the <u>Disable</u> command. The disabled status of an item is indicated by its gray color. You may re-enable it later by toggling the Disable command again.

4.3 Moving and Deleting Items

To move files or folders, simply select them in the Dynast Files Pane, and drag them with mouse. To delete items, select them with mouse, and press the Delete key.

4.4 Logical Folders and Shortcuts

Basically, the table of contents of the final collection representation corresponds to the structure of your physical files and folders, that is, folders correspond to sections in the table of contents, and files correspond to leaf items. With *shortcuts* and *logical folders* you can duplicate certain items in the table of contents, without duplicating the actual documentation to which the table of contents entries point to.

A *shortcut* is entry in the Dynast Files Pane that does not correspond to a physical file or folder, put points to different file or folder that is already in the Pane. Shortcuts are denoted with the arrow symbol ↗, drawn over the icon of the shortcut referent.

A *logical folder* is a group of shortcuts and/or logical subfolders. It is similar to physical folder, but does not have underlying folder in the filesystem. Logical folders are denoted with symbol 📂 (like physical folders, but blue instead of yellow). For an example of usage of shortcuts and logical folders, see Figure 2. Note that you can create shortcuts not only to files, but also to folders. Folder shortcuts duplicate all the contents of the referent folder in the table of contents.
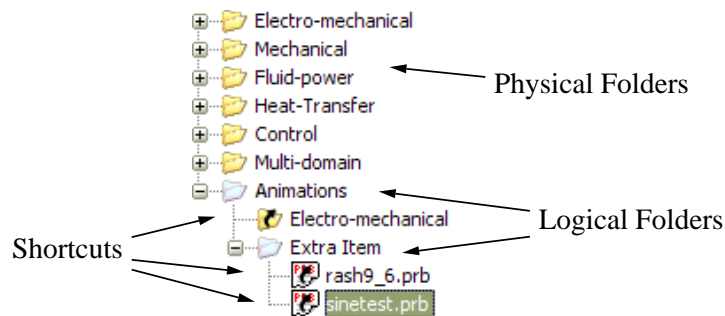

Figure 2 Example of Usage of Logical Folders and Shortcuts

To create new logical folder, select the parent folder, and press the Insert key. After entering the title of the logical folder, new item corresponding to the folder is added to the tree.

To create a shortcut to a file or folder, simply drag the referent file or folder to a logical folder. The shortcut is established after dropping the referent.

Logical folders and shortcuts may be easily moved around in the tree or deleted, just like normal files and folders, see Sections 4.2 and 4.3.

4.5 Icon Summary
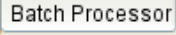
4.6 Exporting Documentation

To export documentation to PDF or HTML formats, switch from the Editor mode to the Batch Processor mode using tabs at the very top of the main frame: [Editor | Batch Processor]. Then select the desired output format by selecting one of tabs at the top of the frame: [HTML] [PDF]. Specify the export options, and press the green Go button below. A new tab right to the Batch Processor tab is added to the bottom line, which is associated with the export report. The tab is blue to indicate that export is in progress;

Table 1 DYNAST Files & Folders Icon Summary

Icon	Description
	Physical folder
	Empty physical folder
	Main problem folder
	Main submodel folder
	Physical problem file
	Physical submodel file
	Disabled Item
	Logical Folder
	Shortcut (in combination with other icon)

when exporting procedure is finished, the tab turns either to green, if the procedure succeeded, or red, if it has failed.

5 The WYSIWYG Documentation mode

5.1 Creating Documentation from Scratch

Assume we have DYNAST problem file, and we want to add documentation to it. When the file is selected in the DYNAST Files Pane, and the documentation system detects that there is no documentation available for the file, the New Documentation Wizard shows up, see Figure 3.

Figure 3 New Documentation Wizard

In the left part of the window, you may select various options to be added to the documentation. The right part of the window previews the document to be created. When you make your selection and confirm the options by pressing the OK button, the documentation is created and opened in the Editor. Then you can add more content to your documentation.
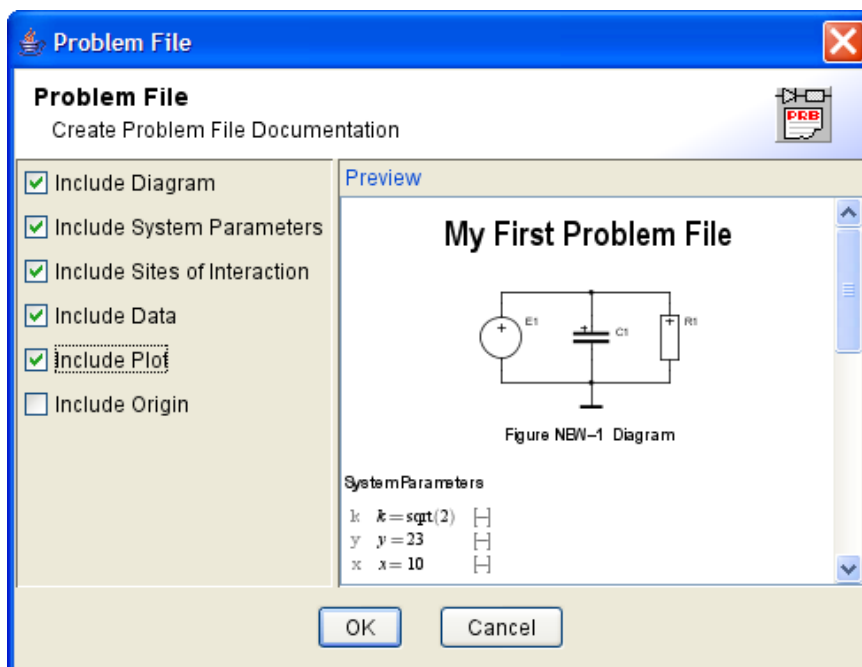
5.2 Editing Basics

The documentation editor is a WYSIWYG (What You See Is What You Get) editor with familiar user interface. With the editor, you can add formatted text, lists, tables, two-dimensional drawings, mathematical equations, and so on. Moreover, you may add more specialized content related to the DYNAST simulation system, see Section 5.3. This section provides only brief introduction into editor features. For more complete reference, see RichDoc Framework Documentation.

5.3 Adding Specialized Content

Besides ordinary text-processing content, you can make up your documentation with specialized objects related to the DYNAST simulation system. This enables you to easily include diagrams, plots, symbols, code listings, or parameter lists. The repertoire of specialized objects is described in the following paragraphs. To add special object to the documentation, use either the Insert menu or a toolbar above the Editor.

System Parameters

System Parameters is section containing list of system parameters defined in your DYNAST file. You may add comments to your system parameters. The list is automatically synchronized with the actual list of parameters defined in the DYNAST file, as described in Section 5.4.

Sites of Interaction

Sites of Interaction is section containing list of important interaction sites in your DYNAST model. The list initially contains single item, but you may add as many items as you need using the Add Row (⬜) or Insert Row (⬛) command from the toolbar.

Diagram (⬚)

Diagram figure shows the diagram associated with current DYNAST file. This command is available only if your DYNAST file has corresponding diagram (`.dia`) file. If you want to change the default size of the diagram, you may select it with the mouse, and drag its lower-right corner. Alternatively, you may specify the zoom factor of the diagram using the toolbar. To select the diagram object, click the diagram figure, and then click the edge of the diagram object, displayed in gray color. Note that you may add other drawing material, such as lines, boxes or text, to the diagram figure, using the Drawing toolbar.

Plot (⬚)

Plot figure displays any of plots from the output file associated with the current DYNAST file. To select the plot object for editing, click it with mouse, and then click the edge of the plot object. You may change the size of the plot by dragging its bottom-right corner. Properties of the plot (variables to display, axis and grid properties, etc) can be specified using the plot toolbar. Like in diagram figures, you may add additional drawing material to your plot figure. You may even have two or more plot objects in one figure. To add second plot object, just copy the existing object either using clipboard operation (press `Ctrl-Insert` and `Shift-Insert`), or drag it with mouse while holding the CTRL key.

Data

Section containing the code listing of the DYNAST file.

Symbol (⬚) (submodels only)

Section containing symbol figure corresponding to the submodel being documented. Before the section can be added to the documentation, you should specify appropriate symbol by selecting it in Library Browser window.

Interface (submodels only)

Section containing the interface (list of formal nodes) of a submodel. You may add your comments and physical dimension specification to individual nodes. The list is automatically synchronized with the actual list of formal nodes specified in the DYNAST file.

External Parameters (submodels only)

Section containing the list of external parameters of a submodel. You may add your comments and physical dimension specification to individual nodes. The list is automatically synchronized with the actual list of formal nodes specified in the DYNAST file.

5.4 Interaction with the DYNAST File

The documentation to DYNAST files is actually stored in the corresponding DYNAST file in the form of a comment. The comment is always at the end of the DYNAST file, and looks something like this:

```
:Warning! Do not alter the following data!
:DYNAST Documentation System v1.0 data
:eJx0vMeyq8yWNdq/EfcddpzOaXCr8C6iTv2ReCS8kAD18MJLeHj6P7X25zp3RWwjkWTOnGbMMMSRy/c//
:2bv215qPUzX0//k3/t/Yv3/lfTpkVV/+5993X/kv7t+/pjnus7gd+vw//z7y6d//53//3//nf7IhXbq8
 ... etc.
```

This comment is automatically updated by the documentation system each time you alter the documentation associated with the file. You should never change this comment in any way, nor add any other comments after this comment.

The documentation system also rewrites comments associated with system parameters of problem files, and formal nodes and parameters of submodel files. This means that if you use the documentation system for documenting the files, you should not modify these comments directly in DYNAST files, but in the Editor of the documentation system. If you change the comment in the DYNAST file, it gets rewritten next time you save documentation of the file.

When you change any of the list mentioned above in the DYNAST file and open the corresponding documentation is displaying that list, the list in the documentation is automatically updated according to the following rules:

1. If you just changed the order of certain items in the list, the items are merely sorted to reflect the new order, but the content of the items is not modified.

2. If you add new item to the DYNAST file, a new item is created at an appropriate place in the documentation. You may add new comment to the item.

3. If you remove an item from the DYNAST file, the item is not removed from the documentation, but is marked as deleted (stroked-through) and moved to the end of the list. You may confirm the deletion by removing the row using the Delete Row command ( ). This is to prevent accidental loss of item documentation.

4. If you rename an item, it is unfortunately not recognized by the documentation system, and is reported as if you added new item and removed another item. You may, however, remove the added item from the documentation, and rename the item that has been marked as removed. Then use the Update command to get rid of the removed status of the renamed item, and to move it to appropriate position in the list.

5.5 Compatability with the LaTeX Mode

If you have DYNAST files documented using the old, LaTeX based documentation system, you can easily import the documentation into the new format. When you select a file having legacy documentation in the DYNAST Files Pane, the documentation system asks you to convert the old documentation to the new format. If your answer is yes, the documentation system backs up the old DYNAST file, converts the old documentation to the new format, removes the old documentation, and opens the converted documentation in the Editor. If you answer no, the system displays the New Documentation Wizard as if you were creating documentation from scratch, see Section 5.1.

6 Creating Animations

DYNAST Animation Tool is application that can be used to visualize DYNAST simulation results with 2D animations. The animations may be deployed as stand-alone files in various formats, or embedded into documentation of the experiment.

6.1 Running the Animation Tool

To run the Animation Tool, open the problem file of the DYNAST experiment, and choose Run → Animation Tool. The Animation Tool Frame shows up, see Figure 4. Note that the experiment should have been run already (using the Run → Run Analysis command), and the corresponding DYNAST output file should exist.
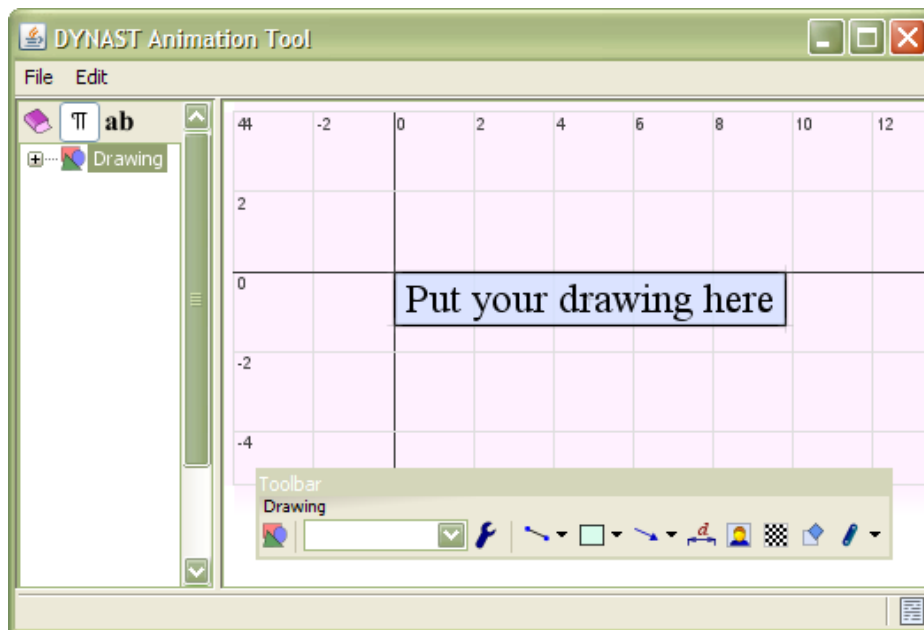

Figure 4 Animation tool frame

The left pane shows list of objects in the drawing, right pane displays the drawing editor area.

6.2 Drawing Static Pictures

In this section, we briefly describe how to setup the drawing that statically depicts the experiment being visualized. For more complete description of the Drawing Editor features, see Drawings Chapter of the Rich-Doc User's Manual.

6.2.1 Adding Elements

When you click on the drawing area, a coordinate space is displayed around the area, and the Drawing Toolbar shows up. The Drawing Toolbar contains tools that can be used to add new graphical objects to the drawing. The tools are described in Table 2.
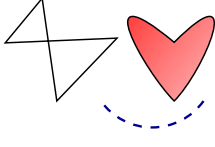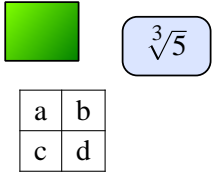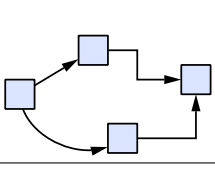
Related tools are collapsed into single toolbar button with a down arrow ▾ next to it, such as ↘▾. You may press the tool button to activate the tool, or the down arrow to choose from a wider variety of tools.

Figure 5 Configuring Shape Tool

Table 2 Basic drawing tools

Drawing tool	How to use the tool	Example
Shapes ⬎		
⬎ Line Tool	Drag mouse to draw shape	
⬎ Quadratic Curve Tool		
⬎ Cubic Curve Tool		
↻ Arc Tool		
Shapes Continuation ⬎		
⬎, ⬎, ⬎, ↻	Click mouse to add segment to selected shape	
Boxes ▢		
▢ Normal Box	Drag mouse to define box shape	
◯ Elliptic Box		
▢ Rounded Box		
▣, ◉, ▣ Text Boxes		
▦ Table Box		
Links ⬎		
⬎ Straight Link	Drag mouse to define link	
⬎ Curved Link		
⬎ Corner Link		
⬎ Rectangular Link		

When some tool is selected, a corresponding row is added to the toolbar. For instance, after selecting the Line Tool ⬎, a new row similar to that depicted in Figure 5 is added to the toolbar. Here you can specify the color, type, and other properties of the shape before it is added to the drawing. You can, of course, modify properties of objects that have been created already.

6.2.2 Changing the Coordinate Space

At the beginning, the drawing objects are placed within standard coordinate space, which is derived from the size of the default font, that is, one unit of the coordinate space is approximately equal to the height of a capital letter. If the default space is not appropriate for visualization of your virtual experiment, you can modify the *scale factor* of the drawing. The scale factor can be set by clicking the properties button 🔧 on the Drawing toolbar.

For an example of changed coordinate space, see Figure 6. By default, the positive direction of the y coordinate is upwards (standard mathematical notation), and the unit size approximately corresponds to text height. By changing the scale factor from the default value 1 to new value 5, and by disabling the `userFlipY` mode, we get new coordinate system depicted in Figure 6*b*. In the new coordinate system, the positive direction of y is downwards (computer graphics notation), and the scale has been reduced to one fifth of the original scale.

Note that changing the scale factor and flip mode has no immediate effect on the appearance of existing drawing. They only influence in which units the properties of objects are displayed and set. That is, you should decide the coordinate space *before* you start drawing your picture.

6.2.3 Transformations

Existing objects in the drawing may be transformed by applying transforming operations to them. The four basic transforming operations are demonstrated in Figure 7.

To create new transform in a drawing, select the drawing, and use its 🔷 toolbar button. The Transform Properties dialog shows up, see Figure 8. Initially, the list of operations is empty. Press the New button, and select one of the four transformation types. The list of operations is populated with parameters

(*a*)   (*b*)
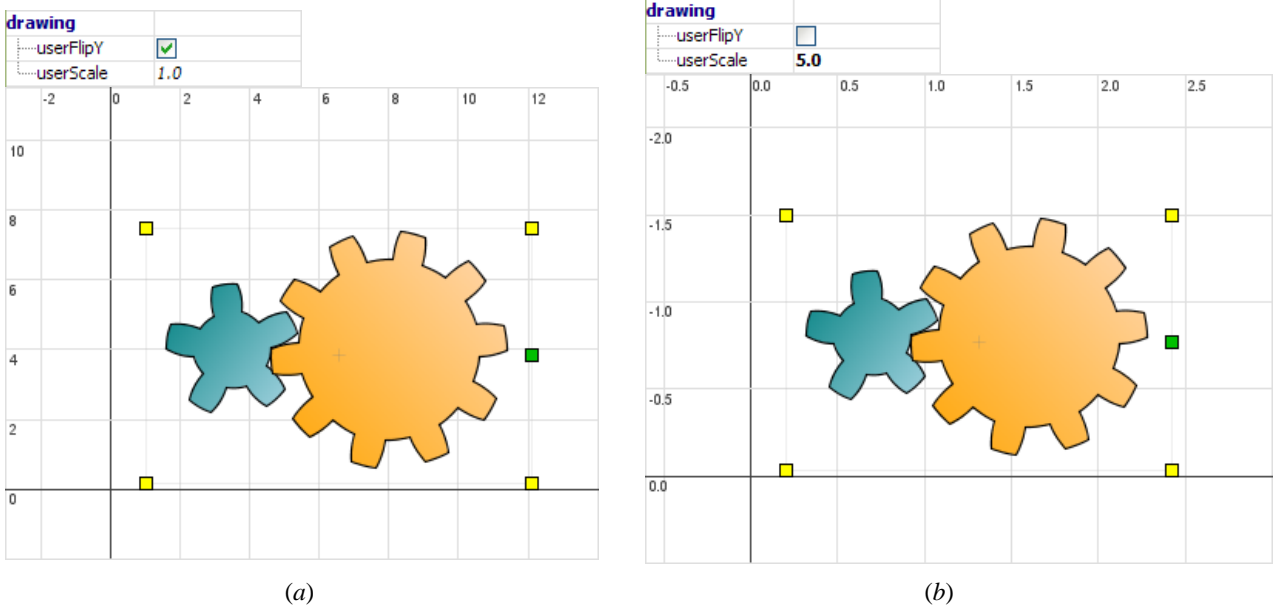
Figure 6 Changing coordinate space: (*a*) default space, (*b*) modified space
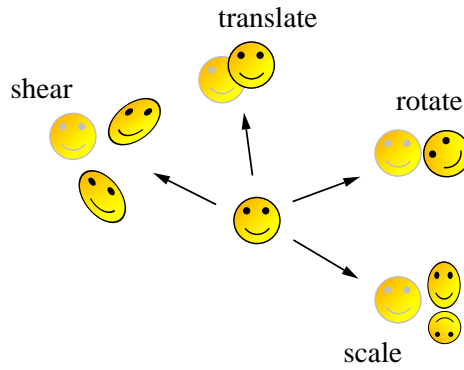
Figure 7 Transforming Operations

corresponding to the created operation. Each transforming operation has different parameters, as specified in Table 3.
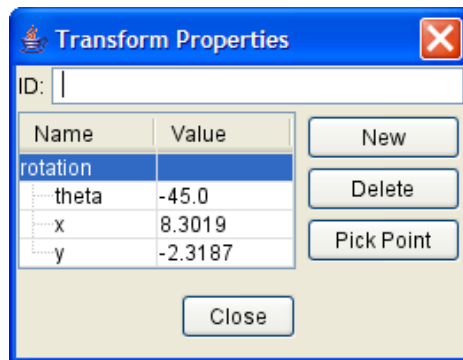
Figure 8 Transform Properties Dialog

Each transformation may have an identifier, which can be set in the Transform Properties dialog. This identifier may be later used e.g. to programmatically change the parameters of the transform, to achieve an effect of animation, see Section 6.3.

Table 3 Parameters of Transforming Operations

Operation	Description	Parameters
↘ Translation	Moves objects by a vector	x, y... translation vector
↻ Rotation	Rotates objects by an angle around a point	x, y... center point, *theta*... rotation angle in degrees (from $x+$ to $y+$), *radTheta*... rotation in radians
✥ Scale	Scales objects	x, y... center point, *sx*... horizontal scale, *sy*... vertical scale; negative scale values may be used to flip the object
⇅ Shear	Shears objects	x, y... center point, *sx*... horizontal shear, *sy*... vertical shear

Note that it is possible to add more operations to single transformation object. The operations are then applied to objects subsequently. For operations having center point, i.e. all operations except translation, it is useful to specify the center point by selecting it directly in the drawing. This can be done by pressing the Pick Point button in the Transform Properties dialog, and then clicking with mouse any point in the drawing underneath the dialog. The x, y variables of the currently selected operation are then selected appropriately.
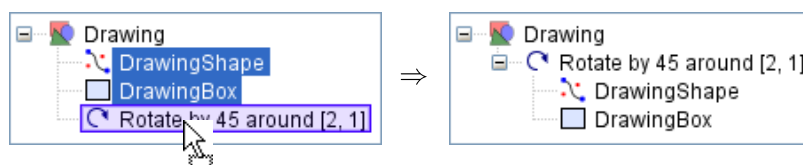

Figure 9 Moving Objects into Transformation

When transformation object is prepared, we need to associate it with drawing objects to be transformed. This can be done by dragging the objects into the transformation in the Document Structure Pane, see Figure 9. When we drop objects into transformation, the transformation's operations begin to apply to its child objects. It is also possible to compose transformations, i.e. a child of transformation may be another transformation.

6.2.4 Smart Shapes

Besides primitive shapes described in section Section 6.2.1, you can also use more sophisticated "smart shapes". The library of smart shapes currently contains only four elements, see Table 4. Advanced users may implement their own smart shapes in the Java programming language.

Every smart shape has a number of parameters that define the geometry of the shape. Some parameters can be defined interactively using manipulation points, such as endpoints of a spring, some must be entered from keyboard, such as number of turns of a spring or number of teeth of a gear. To change numerical parameter of a shape, double click the shape, and specify the parameters in the properties window, see Figure 10.

6.3 Defining Animation Rules

When the static image displaying the simulation experiment is ready, we may proceed with assigning variables to properties of drawing objects to achieve the effect of animation. This can be done using the Animation Rules window, available from the Edit menu, see Figure 11.

Table 4 Smart Shapes

Ground Shape	Spring Shape	Disk Side View Shape
Gear Shape	Arm Shape	Flexible Rod Shape
Meter Shape	Meter Shape	Spiral Shape

Ground Shape: p1, p2, width, minDist, angle

Spring Shape: n, p1, p2, d

Disk Side View Shape: n, p1, p2, angle

Gear Shape: n, delta, c, r

Arm Shape: p2, p1, d

Flexible Rod Shape: n, angle2, p1, p2, angle1

Meter Shape: fineStep, roughStep, fineWidth, p1, p2, 0, 5, 10, roughWidth

Meter Shape: zeroAngle, value, min, max, p1, r2, angle, r1, p2, i

Spiral Shape: phi2, phi1, c, r1, r2

Properties

Show ○ Basic Properties ○ All Properties

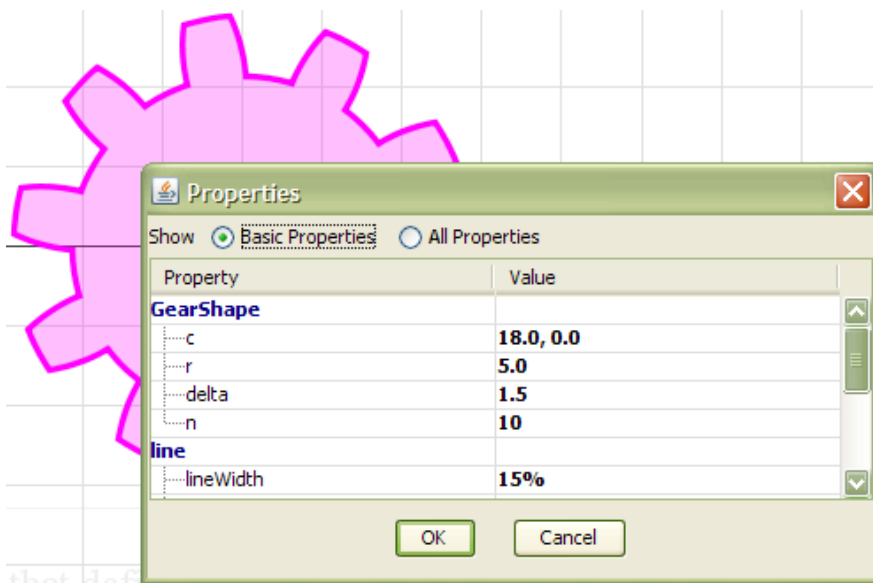| Property	Value
GearShape	
c	18.0, 0.0
r	5.0
delta	1.5
n	10
line	
lineWidth	15%

OK   Cancel

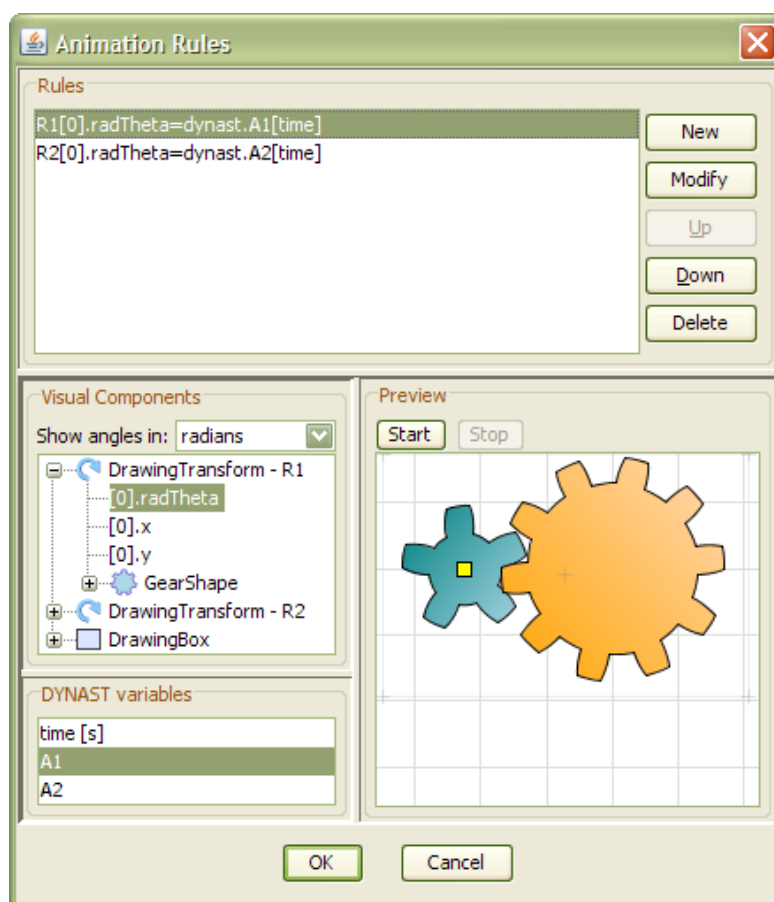**Figure 10 Properties of a Smart Shape**

Figure 11 Animation Rules window

The window contains four panes. The top pane displays a list of *animation rules*. Each animation rule defines which DYNAST variable is assigned to which property of some graphical element of the drawing. The pane on the left displays list of all visual components in the drawing and their properties that can receive numerical values. For complete list of properties of visual components, see Section 6.4. The bottom-left pane shows list of all available DYNAST variables. Finally, the right pane displays the preview of the animation to validate that the animation rules work as intended. You can start and stop the animation using the buttons above the preview.

To define new animation rule, just select one leaf item in the Visual Components list, one item in the DYNAST variables list, and double-click either of these items. A corresponding animation rule is created and added to the list of rules. You can modify the rule later by selecting it in the list and changing items in the Visual Components or DYNAST Variables lists. Note that when you select an item in the Visual Components list, it is highlighted in the Preview pane to show the correspondence. You can also select the visual component directly in the Preview pane, and the corresponding item is selected in the Visual Components list.

The procedure described above allows to define simple animation rules that merely assign DYNAST variables to visual components' properties. If you want to define more complicated rule, you can press the Modify button right to the Rules list, and enter the definition of the animation rule manually. You can, for example, combine more DYNAST variables to define single property, or use various mathematical functions and operators to modify the DYNAST variable before it is assigned to the visual property.

6.4 Visual Components and their Properties

Different graphical elements have different numerical properties that can be used in animation rules. The properties are summarized in Tables 5 and 6.

Table 5 Geometric properties

Property	Description
Box	
object.x	The *x* coordinate of the anchor point of the box. The anchor point is usually the upper-left corner of the box, but it may be changed by setting the anchor property of the box.
object.y	The *y* coordinate of the anchor point of the box.
object.width	Width of the box.
object.height	Height of the box.

Table 6 Other Properties

Property	Description
transform[*n*]*.parameter*	Parameter of *n*-th operation of *transform*. The parameters depend on the type of transforming operation, see Table 3.
object.*color*.*component*	Specific color of given *object*. The *color* may be one of foreColor, backColor, backColor2 or borderColor. The *component* may be one of r, g, b for specifying color components in the RGB color model, or c, m, y for specifying components of the CMY color model. The color components should have value in the interval $\langle 0, 1 \rangle$.

6.5 Deploying Animations

When the animation is ready, you can export it to some output format. The only supported format is currently Adobe Flash. To export animation to Adobe Flash, use File → Export → Adobe Flash command. Then specify the properties of export: output path, and the desired frame rate (number of frames per second). After confirmation, the animation is exported to a file with .swf extension. You can play the file in various applications (such as Web browsers), or upload it to a web server. You can even embed a SWF file to a HTML page, see Flash Detection Kit for more information.