Altair MotionView 2019 Tutorials

MV-100: Introduction to the MotionView Environment

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This tutorial contains an introduction to the MotionView graphical user interface.

Invoking MotionView:

- In Windows - go through the Start Menu (***Start Menu > Programs > Altair HyperWorks installation > MotionView***).

 OR

- In Linux - invoke `~hw_install/altair/scripts/mview` in an "open terminal" (where `~hw_install` is the location where HyperWorks is installed).

The MotionView interface:

MotionView is one of the clients that reside under the HyperWorks Desktop (HWD) framework. The framework provides a common layout for all clients. Other clients that are available under this framework are: Hypermesh, HyperView, HyperGraph 2D, HyperGraph 3D, MediaView, TextView, and TableView. The client is selected, or changed, using the **Client selector** drop-down menu:
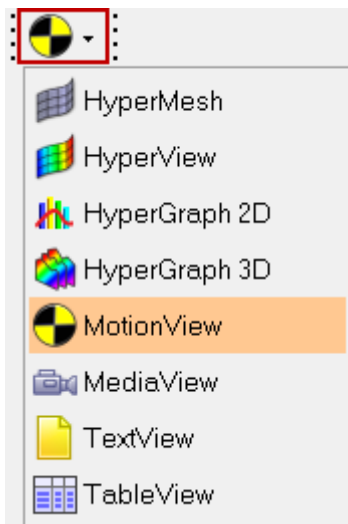
The image below shows the HWD graphical user interface with MotionView activated as the client:
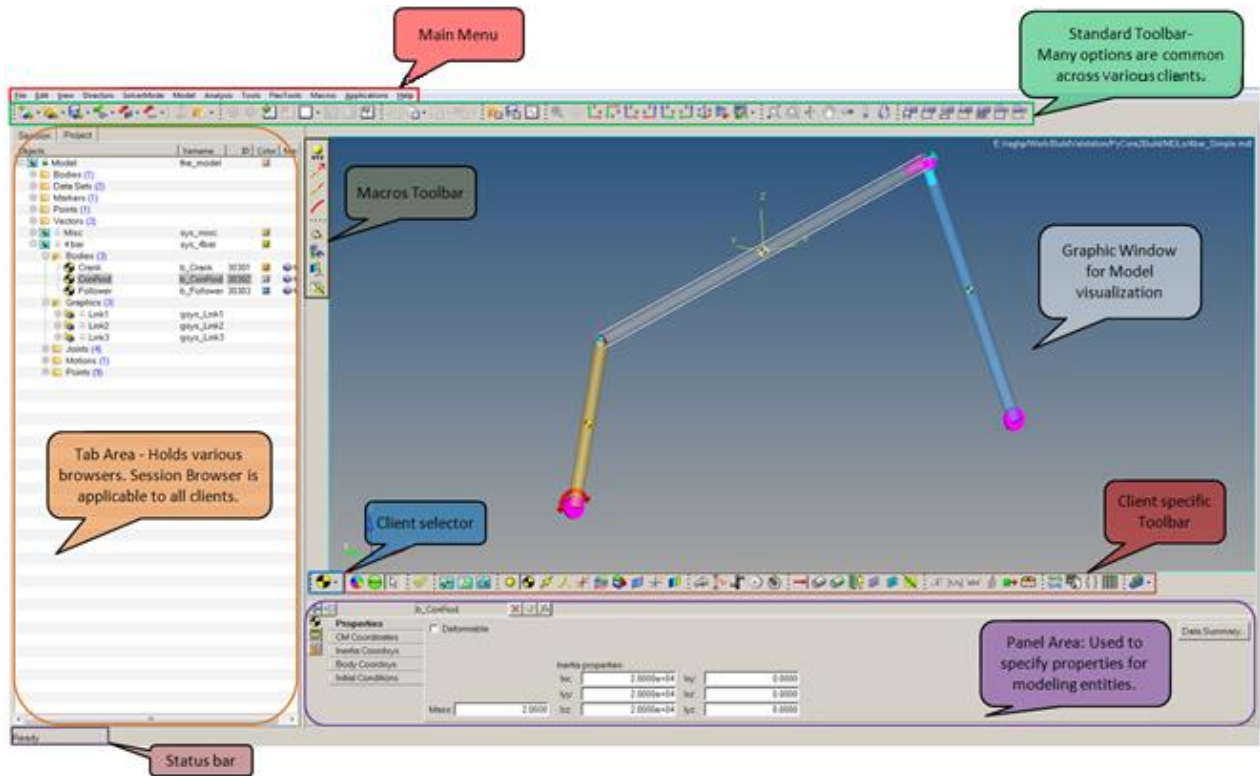
The HWD graphical user interface can be broadly categorized into six segments:

– **Main Menu**

The Main menu bar includes all functionalities that are available through the various toolbars. Additionally, the Main menu contains other useful utilities like FlexPrep, Import CAD/FEM, Macros, etc.
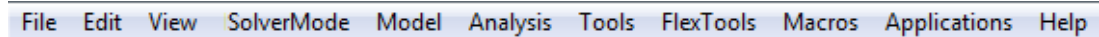
Note - The Main menu varies between the different clients of HyperWorks Desktop.

The following table summarizes the functionalities available in the Main menu of MotionView:

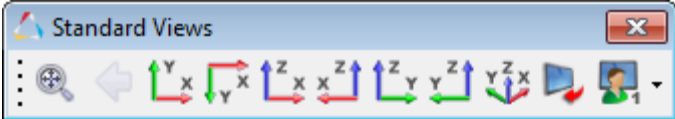| Main Menu Item	Functionality	Alternatives
File	Provides options to manage files (Creating new models, Opening and Saving models/Sessions, Importing and Exporting a Solver Deck, etc.).	The same options are available through HWD Standard Toolbar also.
Edit	Provides options to manage the pages and windows of a session (Cut, Copy, Paste, and Overlay of the page and window).	Same options are available through Page Edit Toolbar also.

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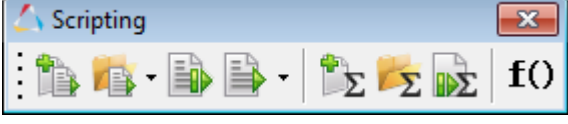|		
View	Allows you to manage the display of the graphical user interface (the display of Browsers, Command Window, Panel Area, Tab Area, Toolbars, etc.).	
Solver Mode	Allows you to switch between solvers modes (MotionSolve, ADAMS, and ABAQUS).	
Model	Allows you to access the following: • Assembly Wizard • Attachment Wizard • Set Wizard Paths • Implicit Graphics • Data Summary • Topology Summary	
Analysis	Allows you to access the following: • Task Wizard • View Reports	
Tools	Provides you with access to various tools and special utilities: • Check Model • Freeze Output Ids • Import CAD or FE using HyperMesh • Model Identification Tool • CG/Inertia Summary • Custom Wizards • Reports • MS UserSub Build Tool • Templex Functions • Options	**Check Model** – Available in **Run** panel.

FlexTools	Provides you with access to various utilities: • Flex Prep – Used for generation and translation of flexbody files. • Flex File Gen - Generates an animation file for ADAMS flexbody results. • Fatigue Prep – Helpful in the translation of MBD result files to other formats useful in fatigue analysis. • Load Export – Allows you to export loads from an MBD analysis.	
Macros	Provides you with access to macros that are useful for modeling and model debugging.	
Applications	Allows you to invoke other HyperWorks applications from the MotionView graphical user interface.	
Help	Provides you with access to the online help.	

– **HWD Standard Toolbars**

Toolbars provide quick access to commonly used features. HyperWorks Desktop toolbars are static and will not change, regardless of which application is active. Some of the toolbars become inactive when different clients are selected. In the table below, all of the HWD toolbars are introduced. Please be sure to note the toolbars that are not applicable to the MotionView client.

Toolbar	Purpose	Image
Client Selector	Selecting the HWD client from the drop-down list.	
Standard	Options for file management (Creating, Editing, Saving, Importing, and Exporting of files etc.).	

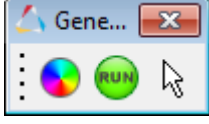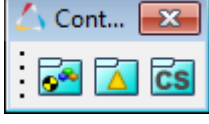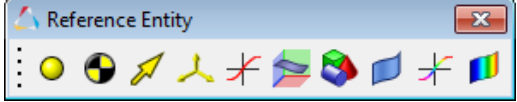△ Altair

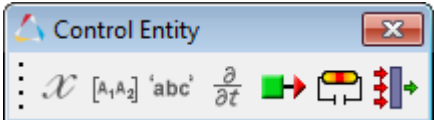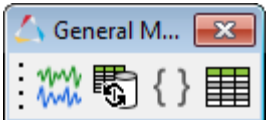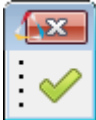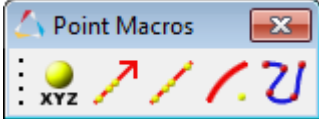|		
Page Controls	Options to: • Create and Delete pages and windows. • Expand, Swap, and Synchronize selected windows. **Note** - To navigate through different pages of a session, use the **Previous Page** or **Next Page** buttons (located at the upper right corner of the window, below the menu bar area and above the graphics area). See the *Page Display and Navigation Area* topic for additional information.	
Page Edit	Options to manage pages and windows of a session (Cut, Copy, Paste, and Overlay of a page and window).	
Animation Toolbar	Provides controls for the animation of results.	 **Note** - Available in HyperView and HyperGraph only.
Standard Views	Options to view model in different orthogonal views.	
3D View Controls	Options to control the 3D view of the model (Rotate, Pan, Zoom, etc.).	
2D View Controls	Options to control the 2D view of plots (Pan, Zoom, etc.).	 **Note** - Available in HyperGraph only.

Reports	Options to Create/Open/Define Report Templates.	
Scripting	Options to Create/Open/Debug/Run Tcl and HyperMath scripts.	 **Note** - Not available in MotionView.
Image Capture	Capture Image/Video of the active page.	

Note - Please refer to the *Hyperworks Desktop User's Guide > Graphical User Interface > Toolbars* topic for a detailed explanation of each toolbar listed above.

– Client Specific Toolbars

Client specific toolbars provide access to options required for pre- or post-processing of FEA/MBD models. MotionView has a set of toolbars for building an MBD model. Each MotionView toolbar group provides access to entities with similar characteristics. For example, all entity such as Joints and Motions are grouped in the **Constraint** toolbar. The table below shows MotionView toolbars with a brief explanation of their usage.

Toolbar	Purpose	Image
General Actions	Options to render graphics, provide access to the **Run** panel (change solver settings and submit jobs to the solver), and the **Entity Selector**. Depressing the **Entity Selector** icon indicates the graphic screen is in entity selection mode. If no other entity icons are depressed, the selection is not filtered to a particular entity (any entity that has a graphical representation on the screen can be selected).	
Container Entity	Select/Add container entities like Assemblies, Systems, and Analyses.	
Reference Entity	Select/Add entities like Points, Bodies, Vectors, Markers, etc.	

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Constraint	Select/Add constraint entities like Joints, Motions, Couplers, etc.	
Force Entity	Select/Add force entities like multi-axial Forces, Spring Dampers, Bushings, Beams, Contacts, etc.	
Control Entity	Select/Add entities like Solver Variables, Solver Arrays, SISO Controller, Differentials, and Sensors which are useful in defining controlled simulations.	
General MDL Entity	Select/Add general MDL entities like Datasets, Templates, Forms and Output Requests.	
Model Check	Checks the model.	
Point Macros	Access point creation macros useful in adding points with respect to a reference frame, along a vector, along a curve and at an arc center.	
Other Macros	Other macros useful in modeling and debugging: calculate angles, find connected entities, create markers for a deformable surface and contact properties editor.	

A left click on an entity icon sets the filter to select that particular entity from the graphic screen, while a right-click on a toolbar icon enables adding that entity to the model (see the Points example below):
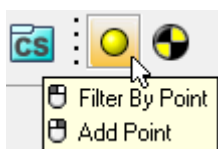
- Left mouse click - Filters selection to a Point entity.

- Right mouse click - Opens the **Add Point** dialog to add a Point.

Note - Mouse over the icons to display a tip about the type of entity that can be selected or added.

- **Browsers**

Tab Area

The tab area docks different browsers, the purpose of the browsers is to navigate through the hierarchy tree and execute some operations specific to the selected items. Available for all clients is the **Session Browser**, which allows you to browse to the different pages or windows in an HWD session, as well as execute certain page and window operations. In addition to the **Session Browser**, client specific browsers are shown based on the active window. For example, when the MotionView is active client in the working window, the MotionView **Project Browser** is shown; similarly, when HyperView is active, the **Results Browser** is shown. Specifically, the MotionView **Project Browser** helps you browse/select different modeling entities, in addition to executing certain modeling operations. Other browsers include the **Organize Browser** (used for data management and collaboration) and the **Process Manager** (used for process automation). Please refer to the client specific online help regarding the available browsers. Finally, browsers can be placed on either side of the graphic window (**Left**/**Right**/**Both**) through the **Menu** bar by using the *View > Tab Area* menu options.

Mouse Options in the Project Browser

A left mouse click on an entity in the **Project Browser** selects that entity and the details of entity are displayed in the Panel area (see the example below):
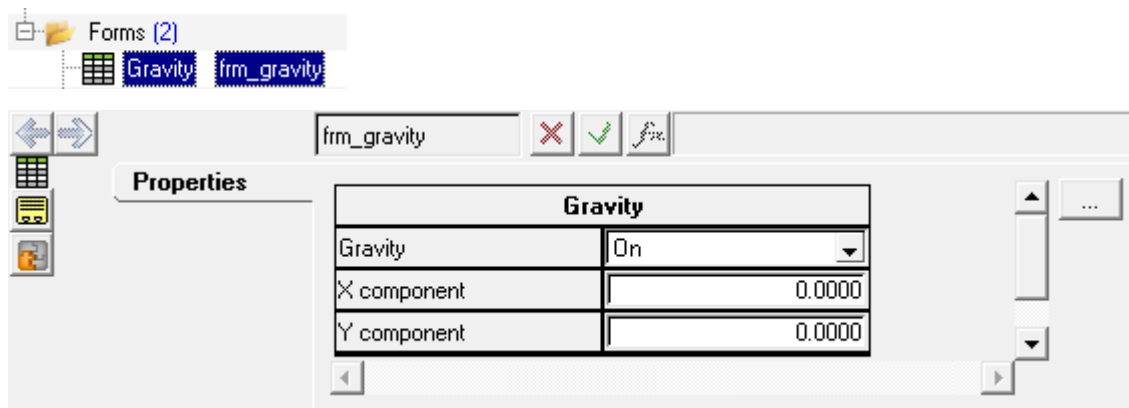

A right click on an object brings up a context menu with options that are relevant to the selected object.

For example, a right click on a Point entity brings up a context menu that provides options to either **Deactivate**, **Rename**, **Add**, **Delete**, or **Cut** the point entity along with options to filter entities.
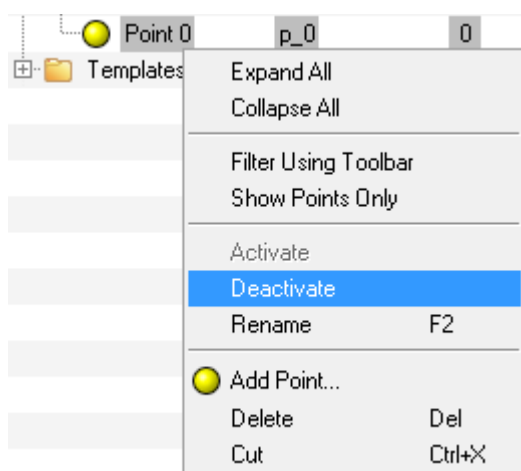
Similarly, a right mouse click on the **Model** (the topmost folder in the browser hierarchy) displays up a context menu with options useful in model building.
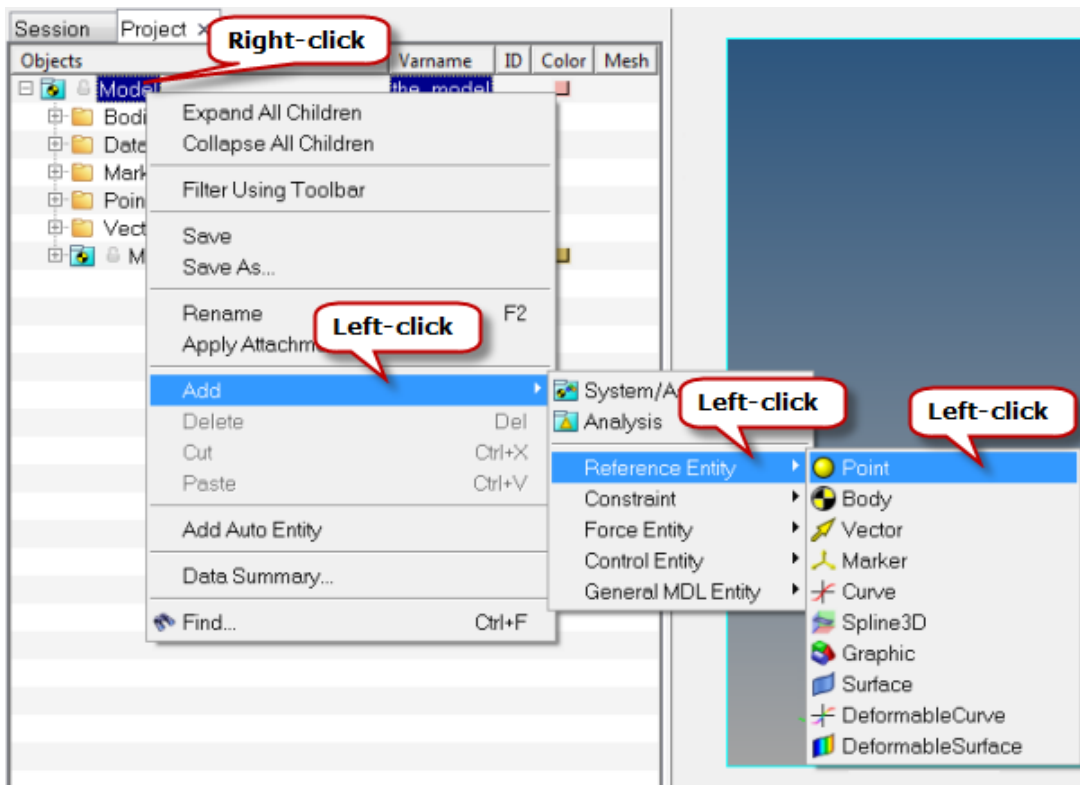

– **Panel Area**

Below the client specific toolbar is the panel area where you can view and modify the various values and properties of a selected entity. Panels may have several tabs which organize the various properties and values of the entity type selected. For example, the **Spring Damper** panel has the connectivity information and properties displayed in three tabs (as shown below):
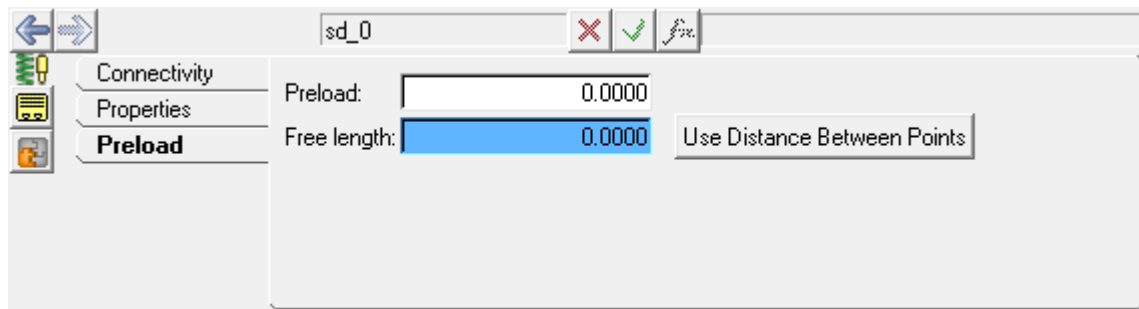
Connectivity tab: Allows you to specify the type of spring, the bodies to attach, and the attachment points.

Properties tab: Allows you to set the stiffness and damping properties of a spring.
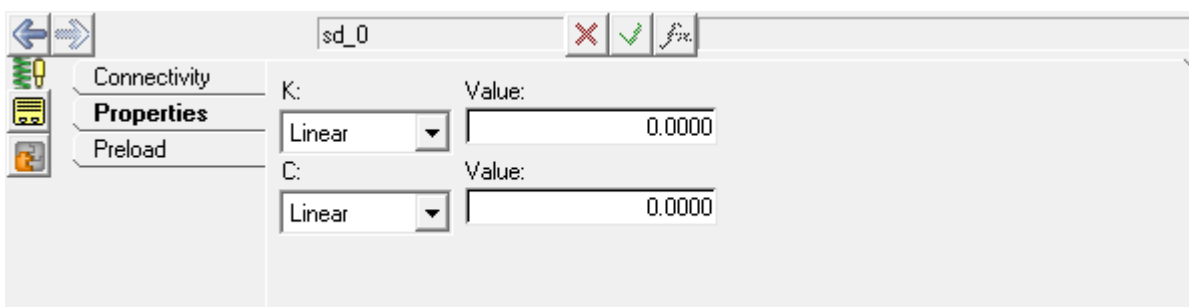
Preload tab: Allows you to set a 'preload' on a spring by specifying a force value or spring free length.


– **Graphics Window**

Graphics window is the model visualization area where you can interactively work on the model.

The following table illustrates the various mouse clicks available for model visualization:

Operation	Action
Left click on an entity like a Point, Graphic, etc. (while the **Entity Selector** and an entity icon is depressed in the toolbar).	Selection (the selected entity is highlighted by a white boarder around it).
Hold the left mouse button and move over the model (while the **Entity Selector** and an entity icon is depressed in the toolbar).	Displays the entity name on the mouse tooltip and selects the entity upon releasing mouse button.
Right-click on a model entity.	Displays a context menu with various options: **Select**, **Cut**, and **Delete** against each entity name.
Ctrl + Left mouse button	Rotates the model (observe the mouse tooltip).
Ctrl + Left click	Picks the center of rotation.
Ctrl + Right mouse button	Translates/Pans the model.
Ctrl + Middle mouse button	Selects the window to fit.
Ctrl + Middle click	Fits the model to the window.

The controls for the mouse can be found under ***Tools > Options > Mouse***:
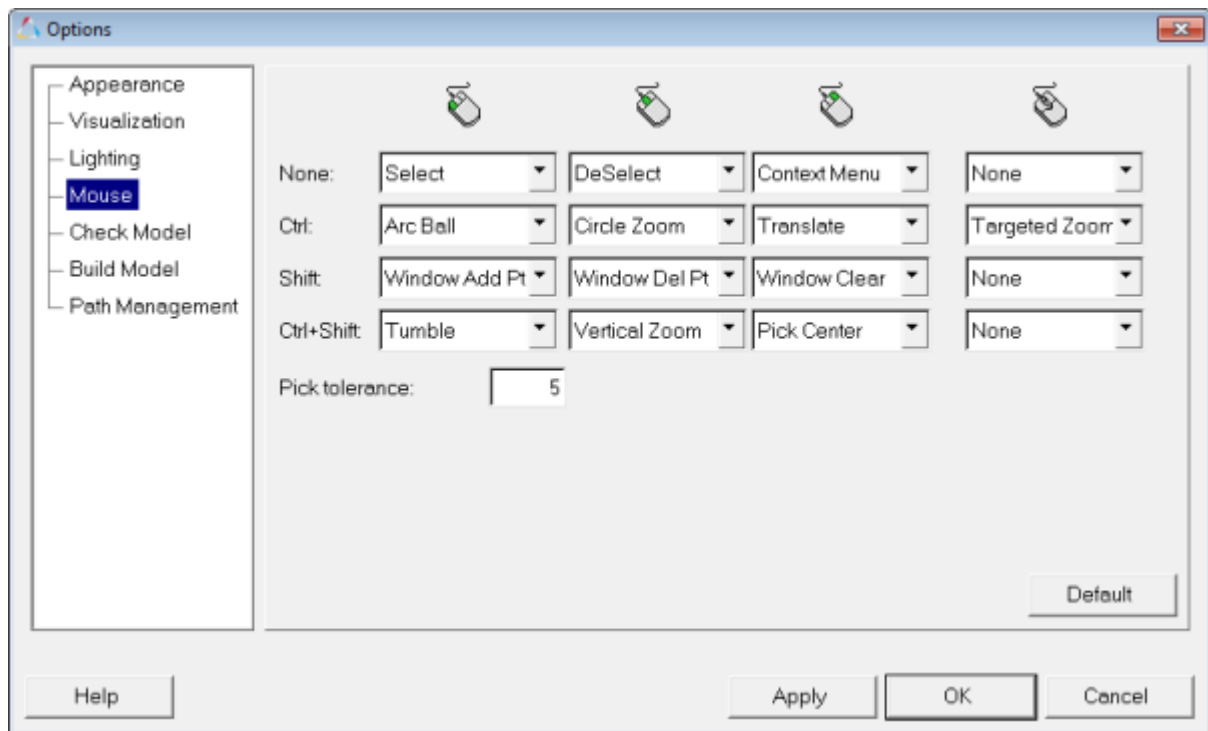
You can customize the mouse controls using this dialog.

Note - The items under the Main Menu, Browser, and Client specific toolbars differ from client to client.

Exercise:

In this exercise you will learn to:

- Open and Save a model in MotionView.

- Add a Page and change the Page Layout in a Session.

- Change between HWD clients.

- Open and Save a HWD session.

Prior to beginning this tutorial, please copy all of the files located in the mv_hv_hg\mbd_modeling folder to your <working directory>. See *Access the Model Files* for additional information.

Step 1: Opening a MotionView model file.

1. Start MotionView:

 – In Windows - go through the Start Menu (**Start Menu > Programs > Altair HyperWorks installation > MotionView**).

 – In Linux - invoke ~hw_install/altair/scripts/mview in an "open terminal" (where ~hw_install is the location where HyperWorks is installed).

2. Click the ***Open Model*** icon, 🐢, on the **Standard** toolbar.

   OR

   − From the **File** menu select ***Open > Model***.

3. From the **Open Model** dialog, locate and select the model definition file
   SingleCylinderEngine_model.mdl, located in your working directory.
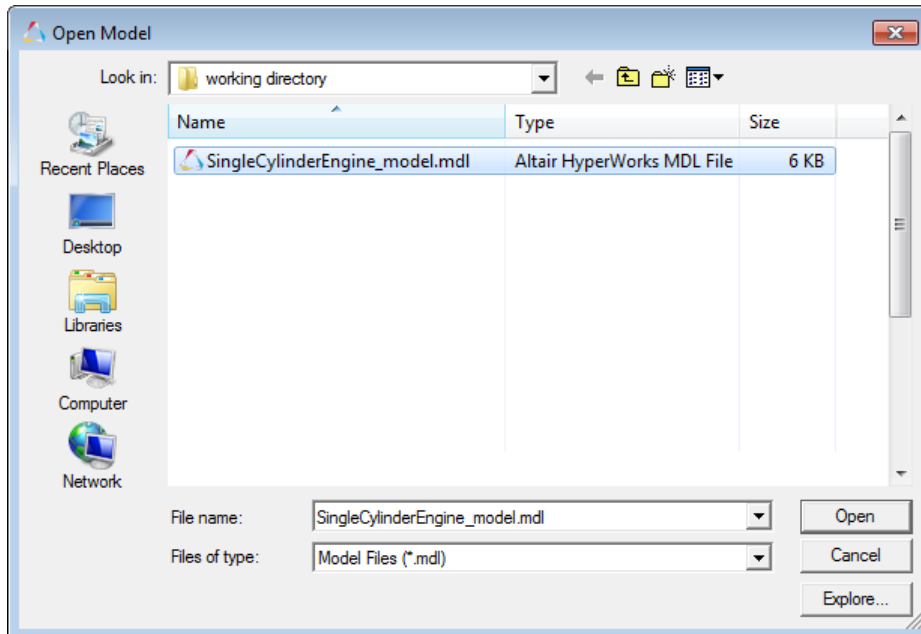

   Note   MDL stands for "Model Definition Language". MDL is an ASCII
               programmable language for modeling in MotionView. See the *MotionView
               Reference Guide* for details about the different MDL statements.

4. Click ***Open***.

   The single cylinder engine model displays in the graphics window (fit to the window).

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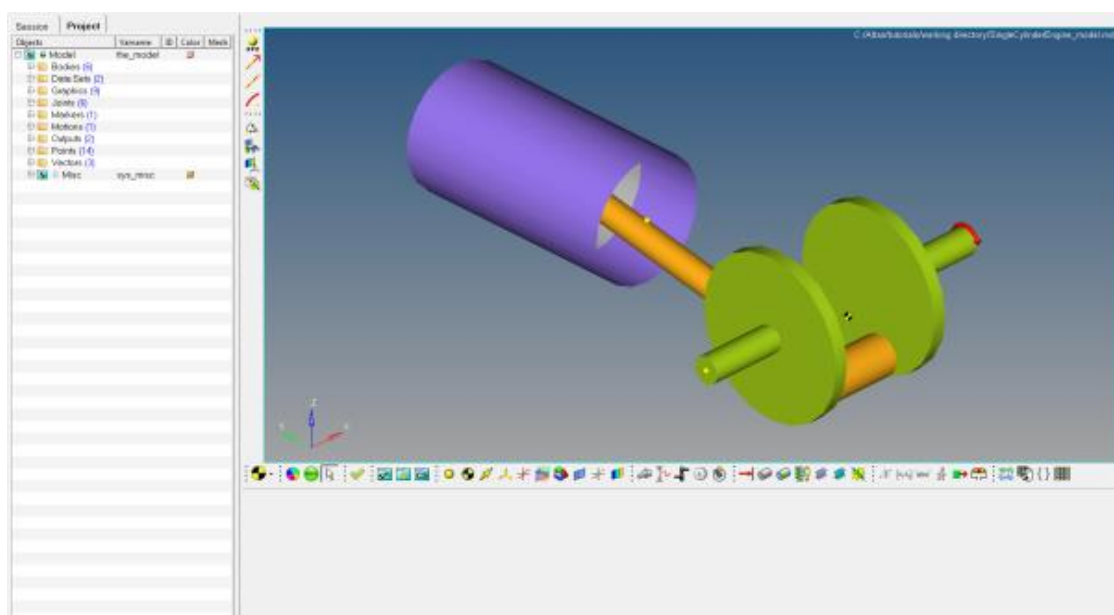
5. Upon successful loading of a model into MotionView, the status bar will display the **Ready** message (in the lower left corner of the screen). The **Project Browser** lists all of the entities in the model. Click on the *Expand* ⊞/*Collapse* ⊟ button of each entity (**Bodies**, **Points**, **Joints**, **Motions**, etc.) to browse through the entities. Use the [mouse controls](#) in the graphics area to rotate, pan, and zoom the model.

6. Expand the **Bodies** folder in **Project Browser** by clicking on the ⊞ next to **Bodies** (⊞ 🗀 Bodies (6)).

7. Click on the *CRANK_SHAFT* body from the bodies listed to review its properties.
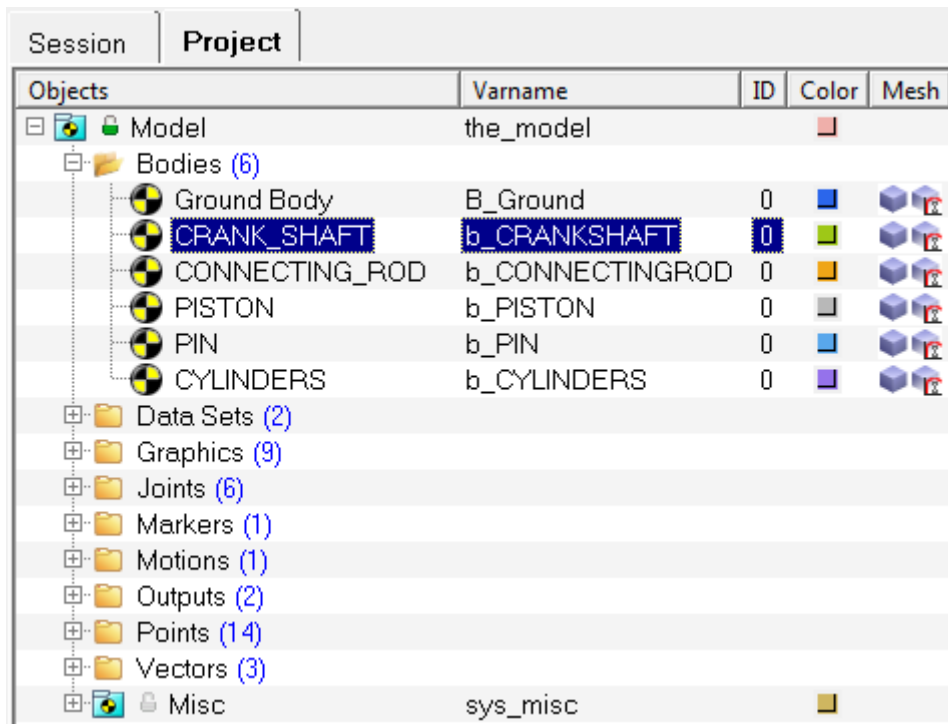
Note   Each entity will have a label and a unique variable name. For example, the crank shaft body has a label of `CRANK_SHAFT` and a variable name of `b_CRANKSHAFT`.

The corresponding entity panel (**Bodies** in this case) is displayed in the bottom of the window.

8. From the **Properties** tab, observe the **Mass** and **Inertia properties** of the body.

△ Altair
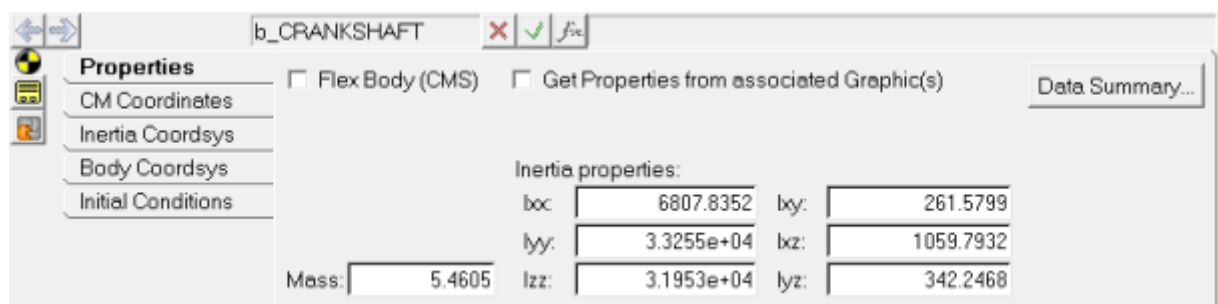
9. Click on **CM Coordinates** tab to review the CM point of the body and its orientation.
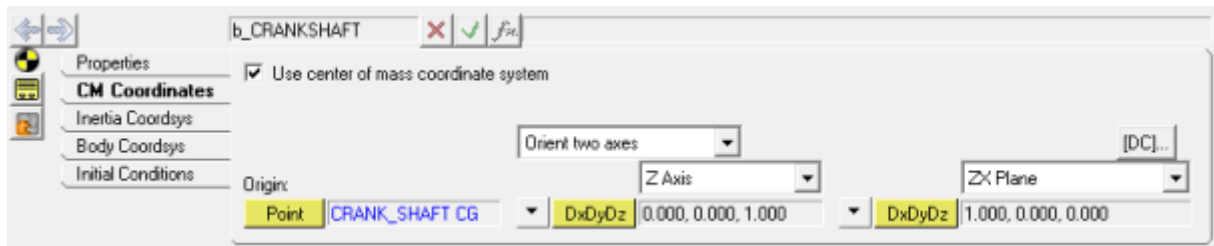
The Origin point defines the body CG location and the orientation is defined with respect to global reference frame using direction cosines DxDyDz.

Step 2: Selecting and modifying a motion.

In this step you will modify the crank shaft rotational velocity to 10rad/sec.

1. Left click the **Motion** icon on the **Constraint** toolbar to change the graphical selection to a motion entity. Move the cursor in the graphics area with left mouse button pressed to identify the motion **CrankShaft Rotation** and release the mouse button to select it.
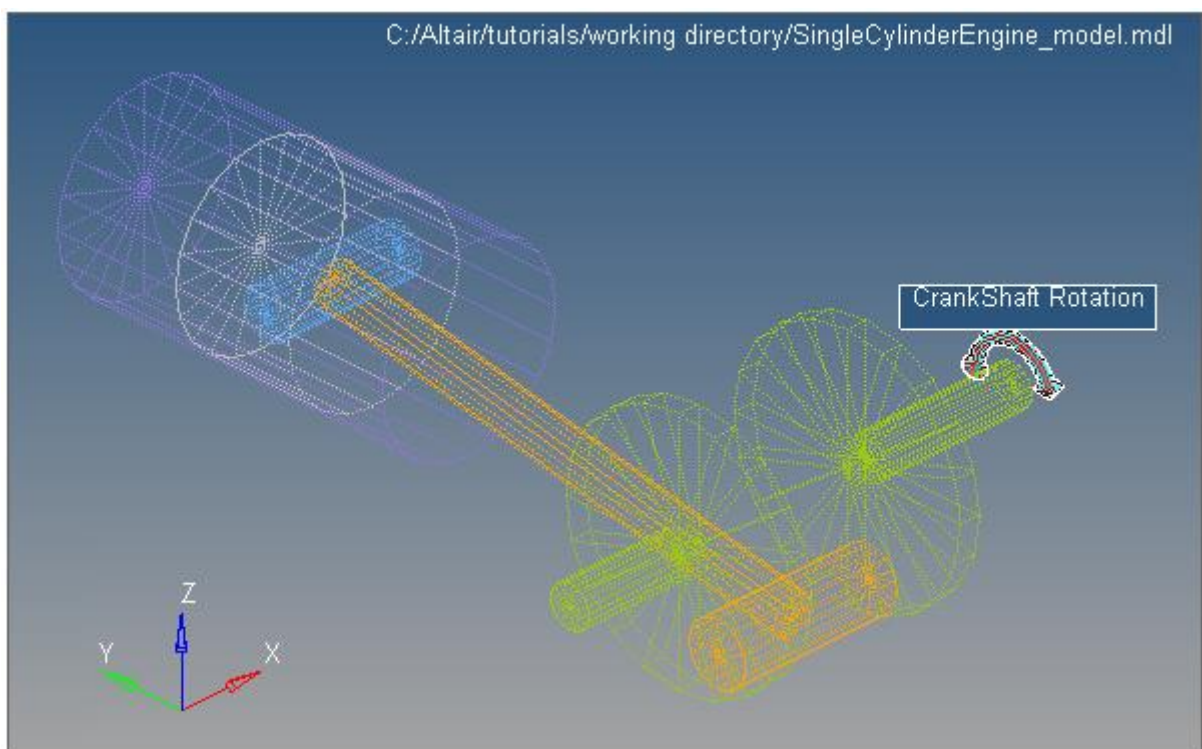

OR

– Browse to the **Motions** entity in Project Browser and click on ⊞ next to **Motions** and select **CrankShaft Rotation**.

Note   Implicit graphics are displayed for all applicable entities, allowing you to visualize their location and orientation. See the *MotionView User's Guide* for details about controlling the visualization of implicit graphics.

2. From the **Motion** panel, click on the *Properties* tab.

3. Enter `10` in the **Value** field.
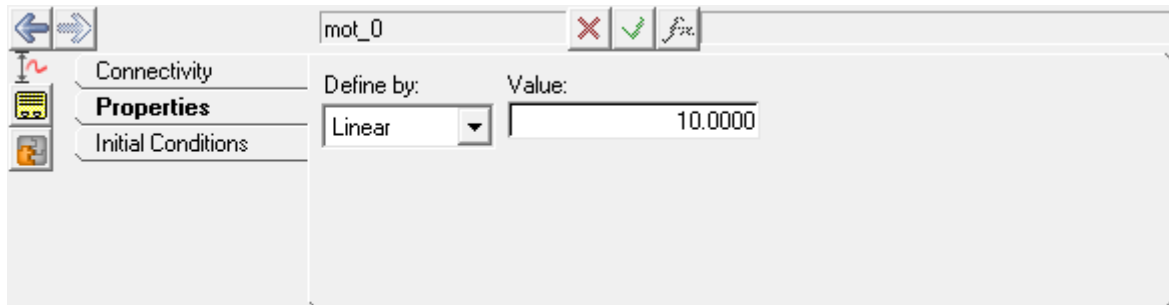
Step 3: Saving a MotionView model.

1. From the **File** menu, select *Save As > Model*.

   The **Save As Model** dialog is displayed.

   Note   You can also click the **Save Model** icon, 🖫, on the **Standard** toolbar to the save the file in working directory with the existing name. If the model is new, you will be prompted to input the name of the model.

2. Browse to your working directory and specify the **File name:** as `SingleCylinderEngine_model_10rad_per_sec.mdl`.
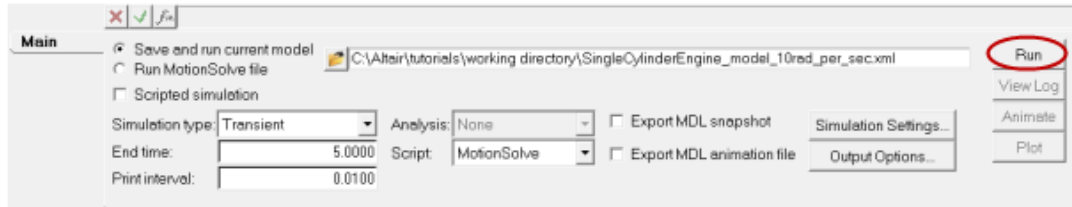

3. Click *Save*.

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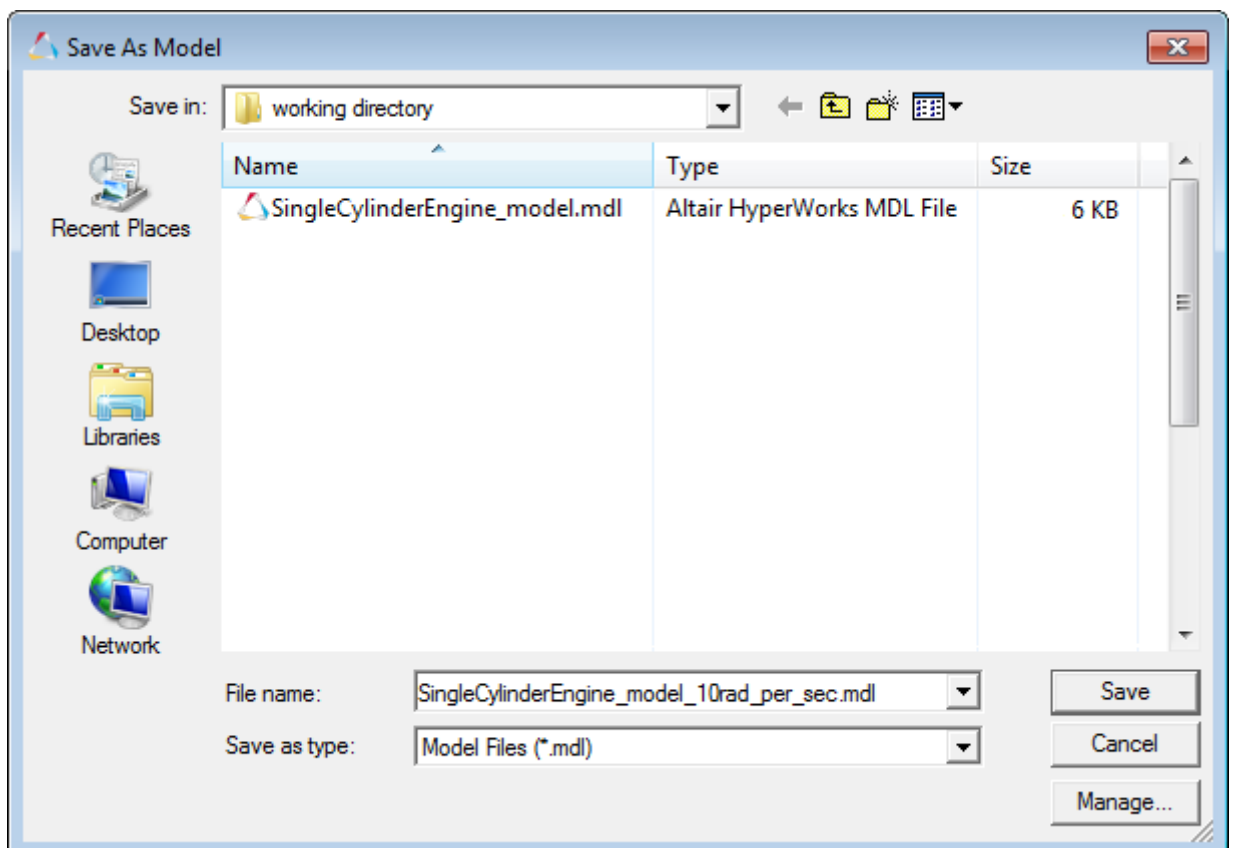
Step 4: Solving the model.

1. Click the *Run* icon, (RUN), on the **General Actions** toolbar.

   The **Run** panel is displayed.

2. Click the *Run* button to solve the model using MotionSolve.

   Upon clicking **Run**, MotionSolve is invoked and solves the model. The HyperWorks Solver View window appears which shows the progress of the solution along with messages from the solver (Run log). This log is also written to a file with the extension `.log` to the solver file base name.

3. Once the job is completed, close the solver execution window.

4. Clear the message log.

### Step 5: Adding pages to a session.

In this section you will learn how to add a page, change to different HWD clients, change the page layout, and navigate between pages. You will also load the result files to view the animation and the plot. Even though there are both **Animate** and **Plot** buttons in the MotionView **Run** panel, clicking those buttons will result in the HyperView and HyperGraph clients opening automatically in different windows on the same page, however in this exercise you will manually do the same on a different page, in order to familiarize yourself with the concept of page and window within the HWD environment.

1. Click on the *Add Page* icon from **Page Controls** toolbar.
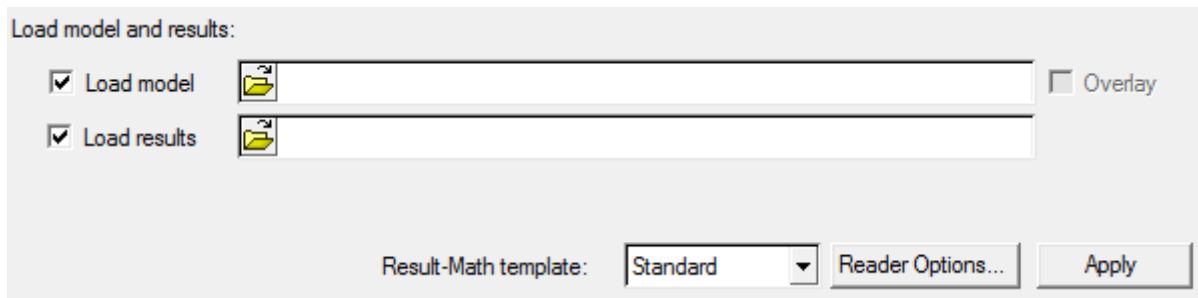
   A new page is added with MotionView as the client.

   Note   Please note that the **Add Page** option adds a page with the current client (MotionView in this case).

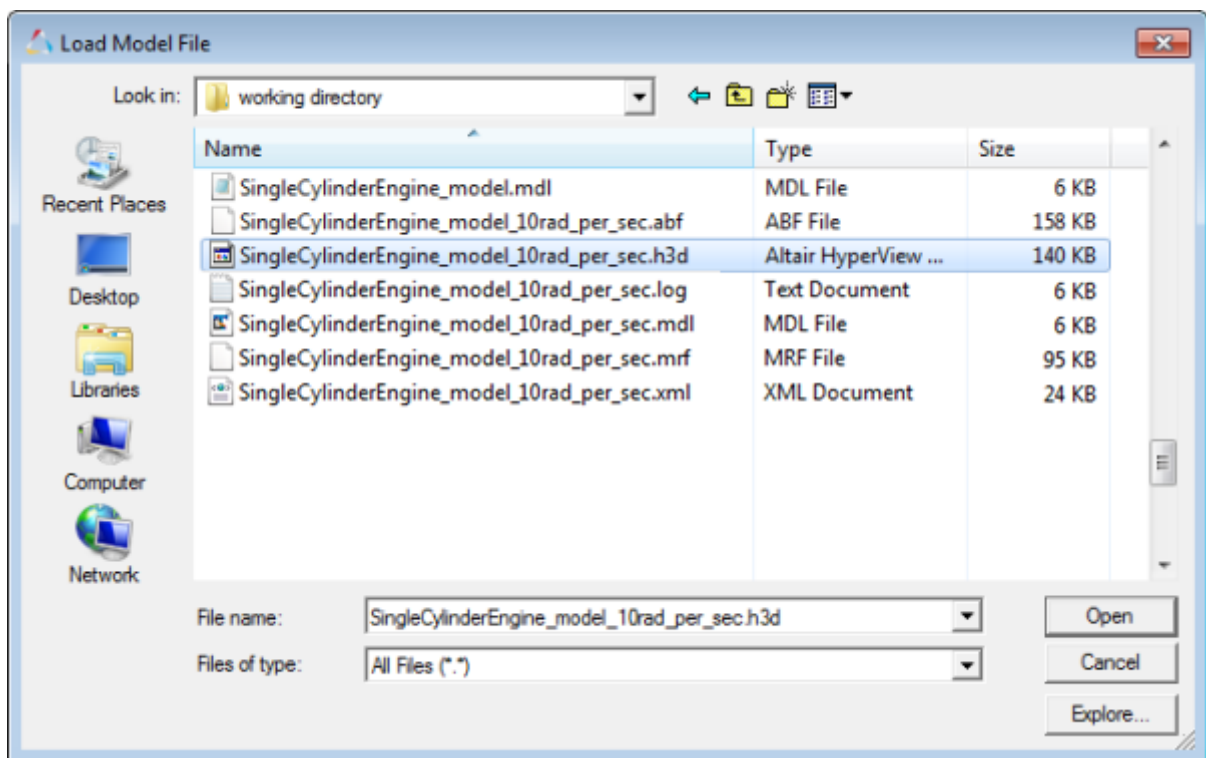2. From the **Select application** drop-down menu, select *HyperView* to change the current window to HyperView.
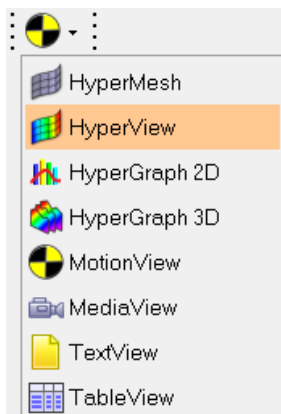
3. From the **Load Model** panel, click on the *Select file* icon 📂 next to **Load model**.

The **Load Model File** dialog is displayed.

4. Browse to your working directory and select the animation results file
   SingleCylinderEngine_model_10rad_per_sec.h3d.

The **Load results** field is automatically populated with
SingleCylinderEngine_model_10rad_per_sec.h3d.

Note   H3D is an Altair binary file for HyperView. The H3D file contains both model
            and results data from a solver run. Please see the Appendix (below) for
            various use cases of H3D files in MotionView/MotionSolve.

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5. Click *Apply* to load the results.
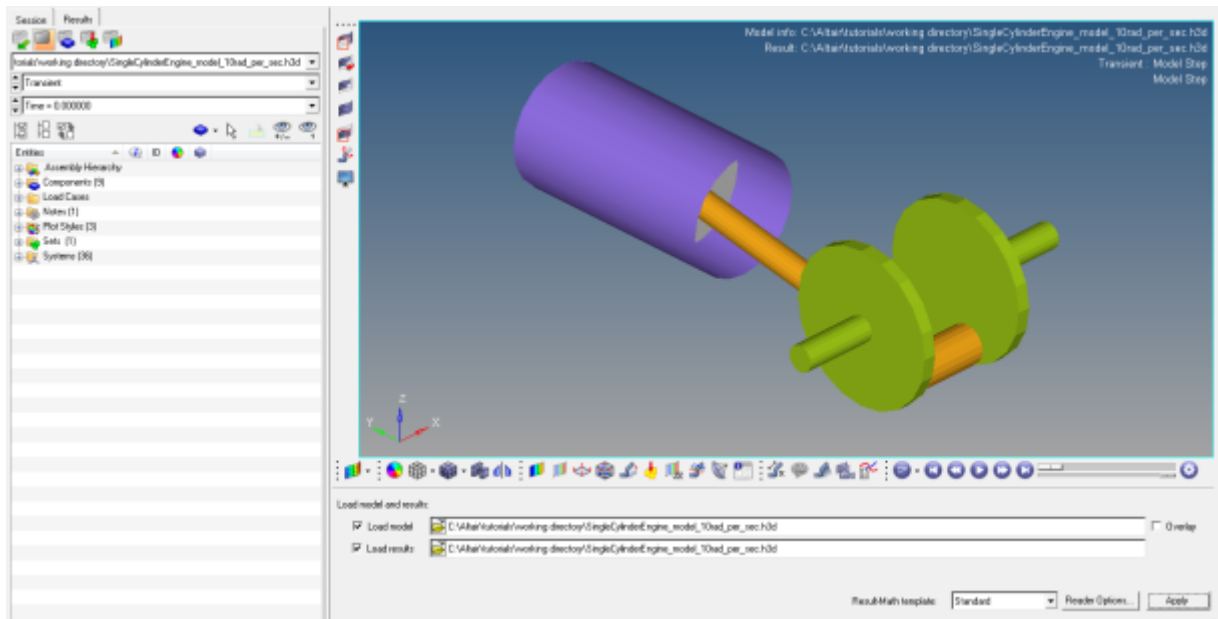
6. From the **Animation** toolbar, click the *Start/Pause Animation* button to animate the results.

7. Rotate, pan, and zoom the model using the <u>mouse controls</u> for better visualization and understanding of the results.

8. Click the *Start/Pause Animation* button to stop the animation.

9. Add a window to the current page to plot the results.

10. From the **Page Controls** toolbar, click the arrow next to the **Page Window Layout** button and select the two window layout from the pop-up menu.


11. Click in the graphics area of second window in order to make it the active window.

12. Use the **Select application** drop-down menu to change the application from *HyperView* to *HyperGraph 2D* .

   **Note**   The **Client selector** displays the icon of the current client (HyperGraph in this case).

13. Click the *Build Plots* icon, , on the **Curves** toolbar.

Altair

14. From the **Build Plots** panel, click the *Open File* icon, 📂, next to **Data file**.
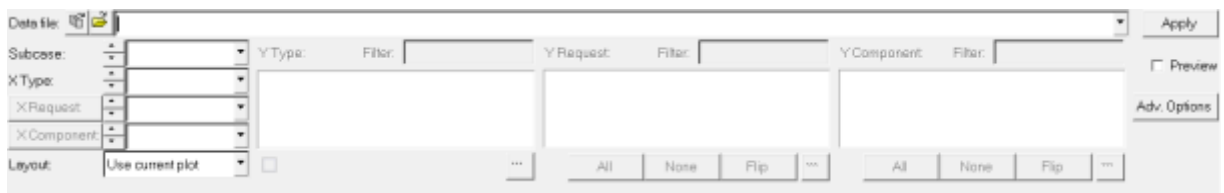
The **Open Data File** dialog displays.

15. Browse to your working directory and select the MotionSolve results file
   `SingleCylinderEngine_model_10rad_per_sec.abf`.
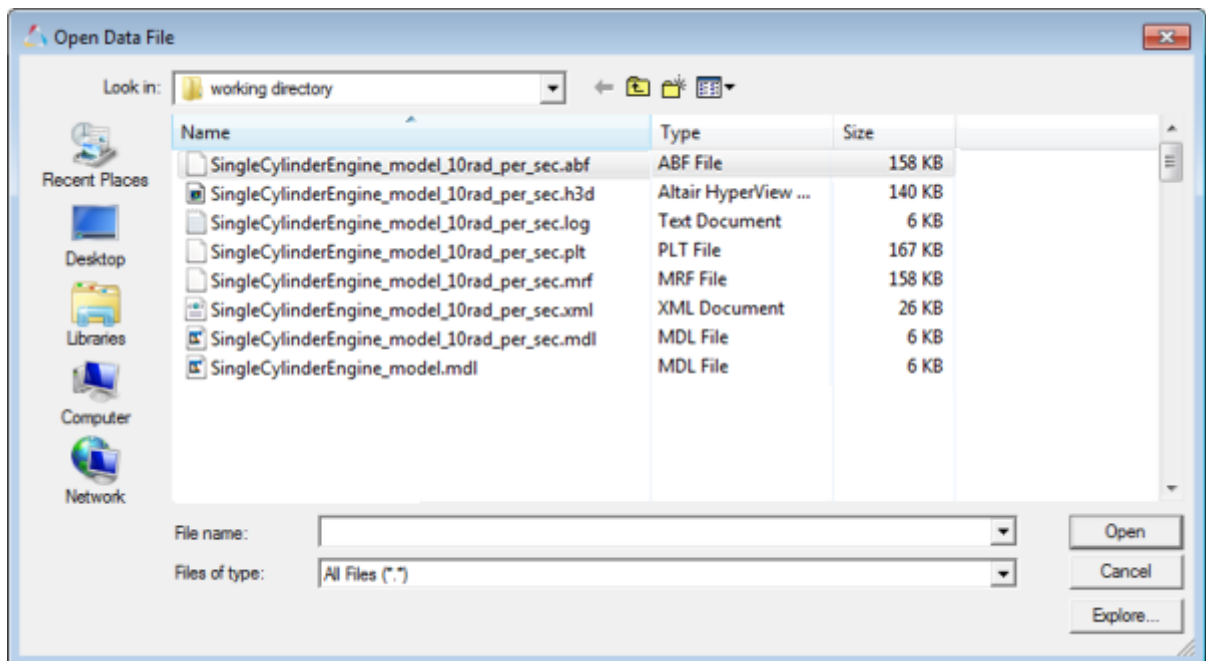
> **Note**   ABF is the Altair Binary File for HyperGraph. Other output files from
> MotionSolve (`.mrf` and `.plt`) can also be used for reading results into
> HyperGraph.

16. Click *Open*.

17. Plot the angular velocities of the crank shaft:

    – For **X Type**, select *Time*.

    – For **Y Type**, select *Marker Velocity*.

    – For **Y Request**, select *REQ/70000002*.

    – For **Y Component**, select *Wx*.

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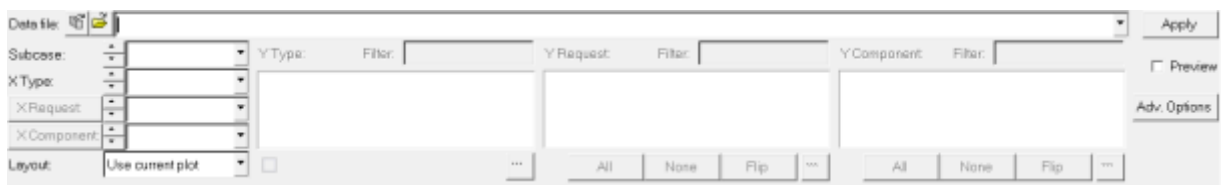
18. Click *Apply* and observe **Wx = 10 rad/sec**.
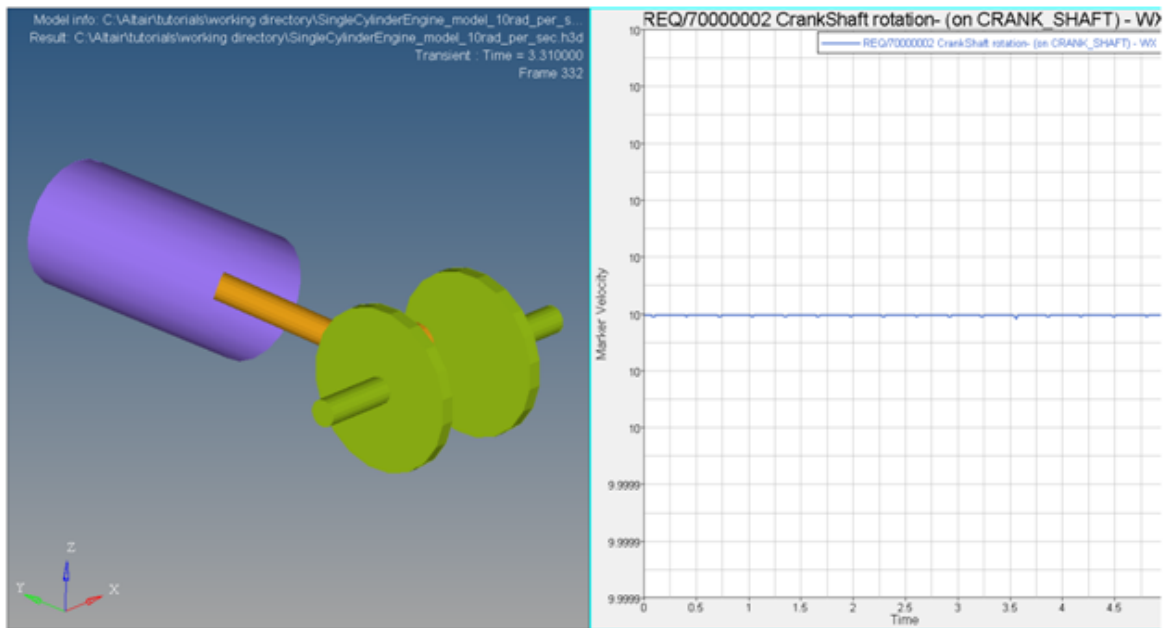
Two Window Layout (with HyperView and HyperGraph 2D)

19. From the **Animation** toolbar, click the *Start/Pause Animation* button 🔵 to animate the results.

20. Click on *Expand/Reduce Window* icon, 🔲 to expand or reduce an active window.

21. Observe the top right corner of the page which displays the current page (**2 of 2**).

    Click on *Previous Page* icon, ⬅ or *Next page* icon, ➡ to navigate to page 1 (the MotionView model).
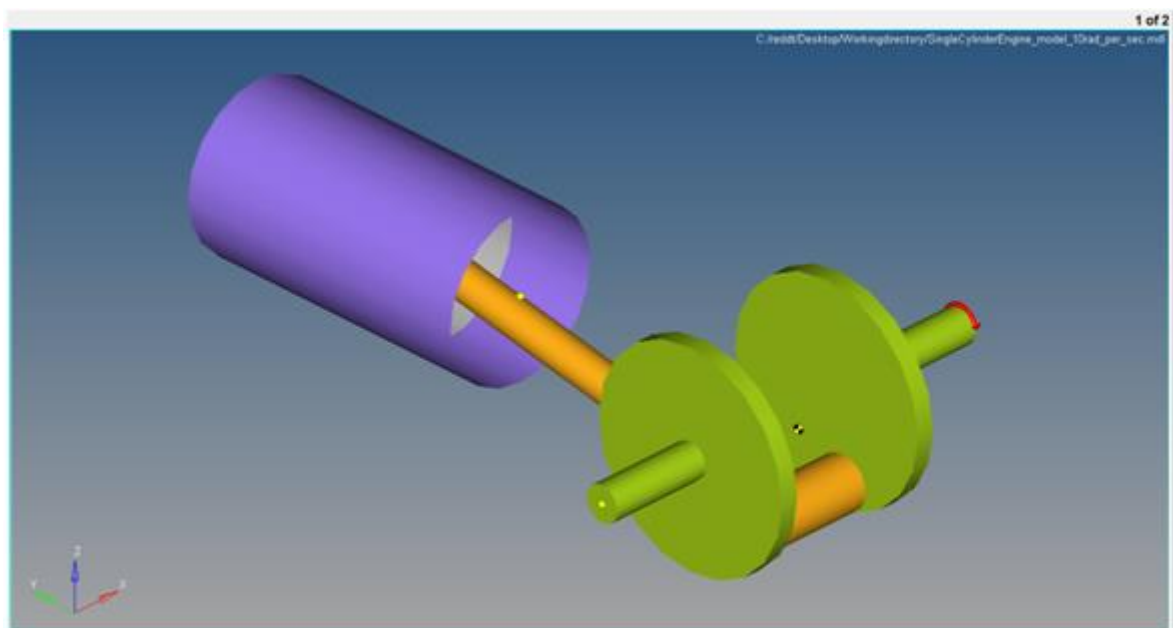
MotionView with Single Cylinder Engine Model

△ Altair

Step 6: Saving a session file.

1. From the **File** menu, select *Save As > Session*.

   The **Save Session As** dialog is displayed.

2. Browse to your working directory and specify the **File name** as `mywork.mvw`.
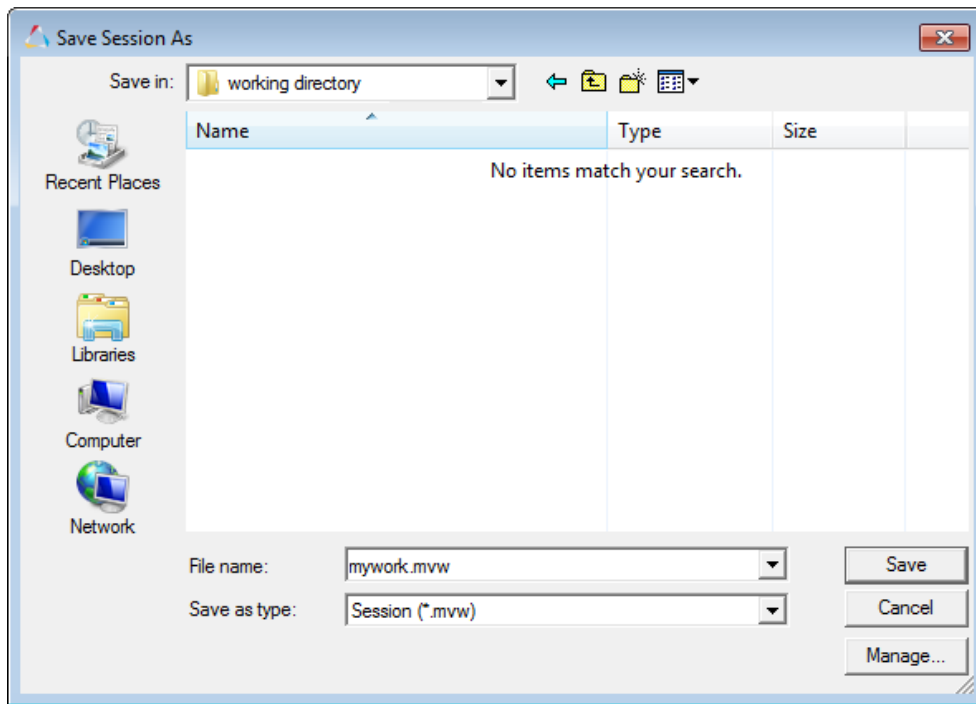
> **Note**   A session file saves the complete HWD data (the page, window, client, and results information). Please refer to the [Appendix](#) below for details regarding the different types of HyperWorks Desktop files.

3. Click *Save*.

   Your work is saved as a session file.

Step 7: Opening a session file.

1. From the **File** menu, select *New > Session* to start a new session.

    Click *Yes* to the message asking if you would like to discard all of the current session data and start new session.
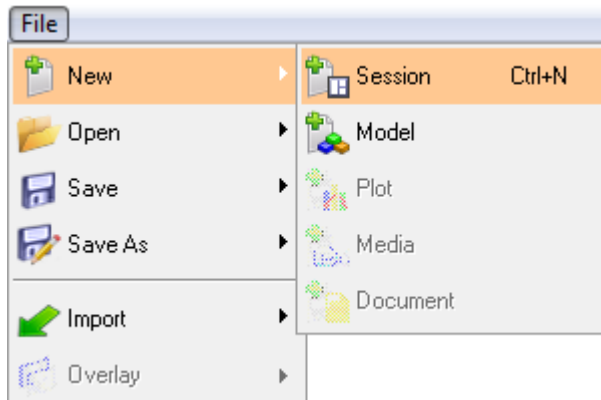
2. From the **File** menu, select *Open > Session*.

    The **Open Session File** dialog is displayed.

3. Browse to your working directory and select the session file saved in previous step *mywork.mvw*.
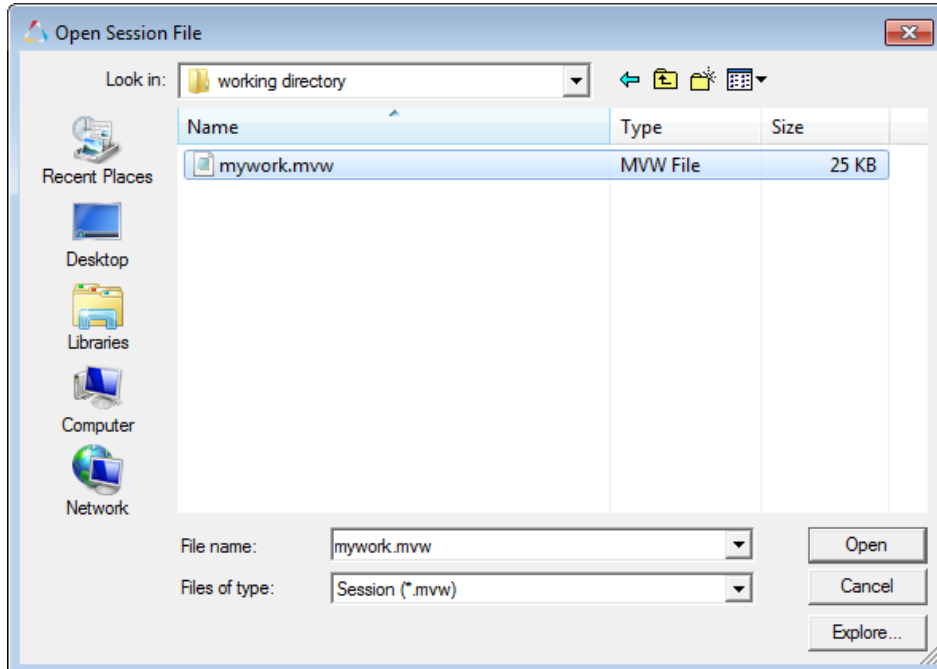
4. Click *Open*.

5. Browse through the pages to look at the model, plots, and animation that you worked on during the exercise using the ⬅ ➡ icons.

– Appendix

HyperWorks Desktop file types:

The following table summarizes the different file types in HWD and the location where the file can be loaded and saved.

File Type	Extension	Window Mode
Session script	.mvw	Any
Report template	.tpl	Any
MDL	.mdl	MotionView
Animation	.gra, .res (Adams and Optistruct), h3d, .flx, .mrf	HyperView
Plot	.req, .mrf, .abf, .plt, .res (ADAMS)	HyperGraph
Templex script, any text file	.tpl, .txt	TextView

Options for loading and saving different file types

H3D file use cases in MotionView/MotionSolve:

H3D is an Altair format for storing model and result information. In general, an H3D file is used for post-processing results in HyperView; however the H3D file has a few other use cases in MotionView/MotionSolve.

Graphic H3D File	This type of H3D contains Model information only. A graphical H3D file is an imported geometry into MotionView for visualization of a body.
Flexbody H3D File	This type of H3D contains Model and Flexible body information. Therefore, MotionView can use it as a graphic, as well as to represent a deformable body by accessing the modes, mass, and inertia information. HyperView can read it as both Model and Results, and also animate the mode shapes, modal displacements, stresses, etc. (if available).
Results H3D File	This type of H3D is written by MotionSolve. It contains Model and Results information. HyperView can read it as both Model and Results, and also animate the position, deformation, stresses, forces, etc.

H3D contains different blocks of information based on the above needs:

- **Model Information** – Nodes and Elements

- **Flexible Body Information** – Modes, Interface Nodes, Mass/Inertia

- **Results** – Position, Displacements, Stress, Strain, etc.