MultiSurf 7.0 Reference: What's New

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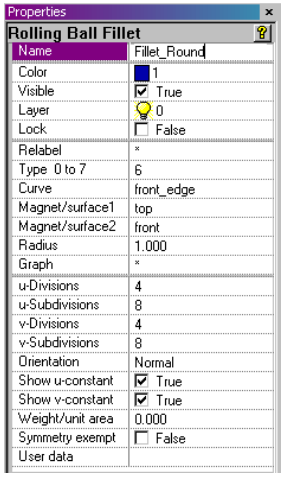
What's New in MultiSurf 7.0

The new functionality added in the release of MultiSurf 7.0 is summarized as follows:

- New Rolling Ball Fillet Types
- New Triangles for Trimmed Surfaces
- New Entities
  - Solve Set
  - TMTrim1
  - CGPoint
- Hydro Balance Component
- Layer Names in Status Bar
- New ShipLines View
- Expanded Multiple Edit
- Enhanced Parent/Child Dialog
- Enhanced Entity Manager
- Enhanced Real Values Dialog
- New Command Window Commands
- Updated Example Files
- New Crypkey version (7.0)

New Rolling Ball Fillet Types

Rolling Ball Fillet



A rolling-ball fillet is the envelope of a continuous family of spheres that contact two surfaces. There is primary interest in rolling-ball fillets of constant radius, because these can be machined with a ball-end cutter of the same radius. There is secondary interest in rolling-ball fillets of variable radius.

Characteristic data

relabel
curve
magnet/surface1
magnet/surface2
kind
radius
graph

The *relabe*l is used to modify the parameter in the v direction on the fillet surface

Each *magnet/surface* support specifies one of the two surfaces the fillet is to join. Magnets can be used to guide the construction in finding the initial ball position.

The *curve* serves only to specify a family of planes in which the construction occurs; the planes are normal to the curve. An Intersection Snake along the surface-surface intersection is one possibility, but there are many others, for example:

A SubSnake made from an Intersection Snake

Any kind of snake on *surface1*, that has been used as an edge in the construction of *surface2*

An Edge Snake of *surface1*, where *surface1* has been constructed from a snake in *surface2*

(Why not just specify 2 surfaces? Because then an Intersection Snake would have to be constructed internally; and we would have to choose its orientation arbitrarily. A curve or snake gives much more information about the user's intent.)

kind tells which of 8 possible fillets you want to construct along this intersection:

0 = on the side of positive normal on both surfaces

1 = negative normal on surface1, positive on surface2

2 = negative normal on surface2, positive on surface1

3 = on the side of negative normal on both surfaces

(4-7) = These all make full tubes; the type selects the quadrant based on positive or negative normal directions for the two surfaces, and would just be the fillet type, plus 4.

radius = dimensional value (length units)

graph = unitless multiplier of *radius*. Default graph * is constant = 1.

Errors

470 -- Zero velocity point on curve support; the normal plane is indeterminate.

471 -- Construction failed.

472 -- The curve is not sufficiently smooth to serve as a path.

Examples

BenchFilletsStart.MS2 - Rolling Ball Fillets applied to bench corners. See the MultiSurf Forum for components to blend fillets.

BenchFilletsEnd.MS2 - Rolling Ball Fillets blended with the aid of components available from the MultiSurf Forum.

Rolling Ball.MS2 – Basic Rolling Ball Fillet with Ruled Surfaces used to finish construction of tangent surfaces.

Rolling Ball Type_6.MS2 – Full Tube Rolling Ball Fillet

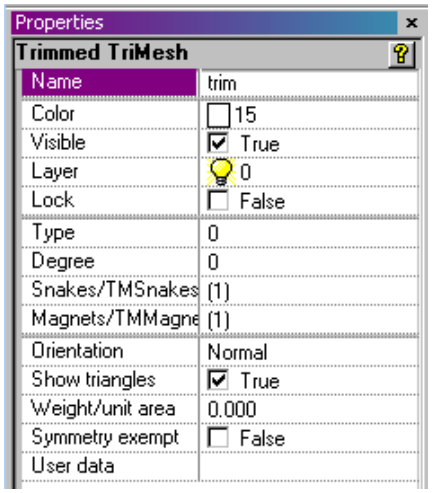
New Entity Types

Trimmed Trimesh

A Trimmed Trimesh is a portion of a triangle mesh enclosed by a boundary of Trimesh snakes. (This is highly analogous to a Trimmed Surface.)

Characteristic data

Name -- as with any entity
Color -- as with any graphic entity
Visible -- true/false
Layer -- as with any entity
Lock -- as with any entity
Type – 0–3 changes triangle distribution
Degree -- Coarseness of triangles
TMSnakes -- Bounding snakes off the trimesh boundary
TMMagnets -- Indicate which portion of the trimesh to keep
Orientation – as with any trimesh entity
Show Triangles -- Off shows boundary only
Weight/Unit Area -- as with any graphic entity
Symmetry Exempt -- as with any graphic entity
User data -- as with any entity



There are currently 9 types:
0 = the old TMTrim1
1, 2, 3 = the new "wide fence" kind, with fence width 0.20, 0.40, and 0.60 times the local average size of base-trimesh triangles
4, 5, 6 = the same 3 fence widths, but showing the fence triangles only
7, 8, 9 = the same 3 fence widths, but showing the tiling triangles only
Kinds 4-9 are for debugging purposes, and have no other known utility.

The boundary TMSnake divisions and subdivisions are used in generating the coving triangles. The snakes should have subdivisions that are roughly similar in size to the base-trimesh triangles they are crossing. Too few subdivisions on the snakes can cause triangulation failures.

CGPoint

Characteristic data

Name -- as with any entity
Color -- as with any graphic entity
Visible -- true/false
Layer -- as with any entity
Lock -- as with any entity
Entity List – List of entities with weight, *WEIGHTS can be used
Weight -- Not editable – grayed out sum of all entities in Entity List
User data -- as with any entity

CGPoint is a point-class entity type that encapsulates calculation of the total mass and center of gravity of a set of graphic objects. By a special convention, this set can be all the weighted objects in the model.

There is a new system object named *WEIGHTS. It can serve as a list, and when doing so, it means the list of all objects in the model with non-zero unit weight.

The CGPoint location is the center of gravity of the graphic objects in the expanded list (or in the entire model, in case the list is *WEIGHTS). The mass (and unit mass) of the CGPoint is the total mass of the same set of objects. Symmetry images are taken into account transparently in making the calculation.

Unlike all other graphic entities, unit weight is not an editable property of a CGPoint. The edit field in the Properties Manager could be omitted, but I'd prefer to have it grayed out so you could read the weight total there.

Solve Set

Characteristic data

Name -- as with any entity
Layer -- as with any entity
Lock -- as with any entity
Type – 0 (Dormant) or 1 (Active)
Log Tolerance
No. Free – Number of solve operations
Entities – Entities required for solve
User data – as with any entity

The Solve Set allows a fairly general set of constructions that we can't perform with the entity set.
To Solve, we specify a set of entities with the following structure:

One or more free objects, having altogether N degrees of freedom
N pairs of (real, real or point, surface/plane) objectives.

At least one entity in each objective pair has to be a descendant of at least one free object. The Solve Set seeks to adjust each free parameter so as to simultaneously satisfy all of the objectives (zero clearance). Unless the objectives are all linear, which is possible, this is necessarily an iterative procedure. If the iteration converges within the log tolerance, the Solve operation is successful, and all the objects involved are left in updated positions.

The Solve Set, when *type* is Active, makes the solution a durable part of the model.

Examples

SOLVESET.MS2 – Solves for given v-belt length as well as tangency of the v-belt elements.

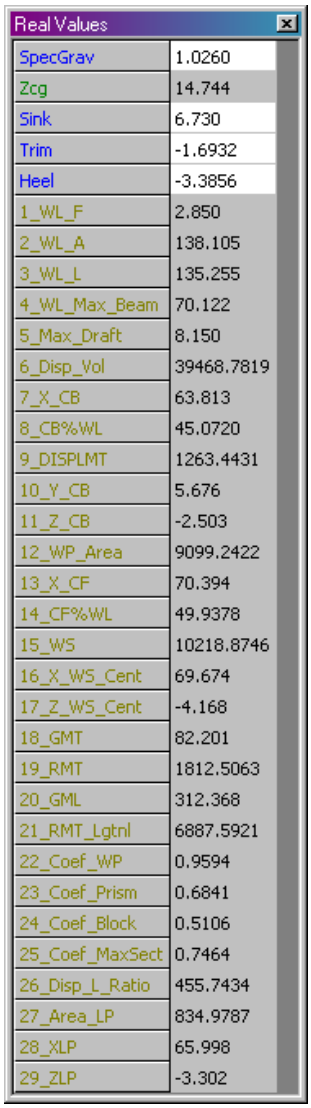
Hydrostatics

Hydro Balance Component

As a preliminary move towards an advancement of our Hydrostatic capabilities, AeroHydro has incorporated Hydro functions in the Relational Geometry Kernel. Now real time hydrostatic balancing is available right inside the MultiSurf user interface. This is accomplished by loading a component to interact with existing geometry.

All the component requires is an Entity List of all contour objects intended to be used for hydrostatics. Even if only one set is to be used, it must be included in an Entity List.

Once to component is loaded, the Entity List 'Hydro' can be selected and the Real Values Dialog opened to contain the contents of that Entity List.



The Variables, Formula, and HydroReals included in the dialog to the left are added to the model with the Hydro Balance Component.

Other items added to the model is a CG Point, a balance frame, and an Entity List you can use to delete the Hydro Balance Component.

The balance is achieved through the use of a solve set, which solves for Sink, Trim, and Heel. The values are reflected in the Real Values Dialog and a graphical representation in the form of the balance frame.

Copy surfaces can be built in the balance frame to have a view of the vessel floating according to the weight and load distribution.

For a video on the use of the Hydro Balance Component click here, or go to http://www.aerohydro.com/Videos/hydrobarge.wmv

The component, Hydro.mc2, is located in the MultiSurf Examples folder.

General Enhancements

New Ship Lines View

What's New

An option to reverse or not reverse the x-coordinates of the ship lines view.

An option to specify the positions of the origins of the different drawings that make up the ship lines view.

An option to separate out the lifts into a format of rows and columns when the user selects to display station, buttock or waterline lifts.

Grid lines are now able to be added to the shiplines view.

Reverse X-coordinates

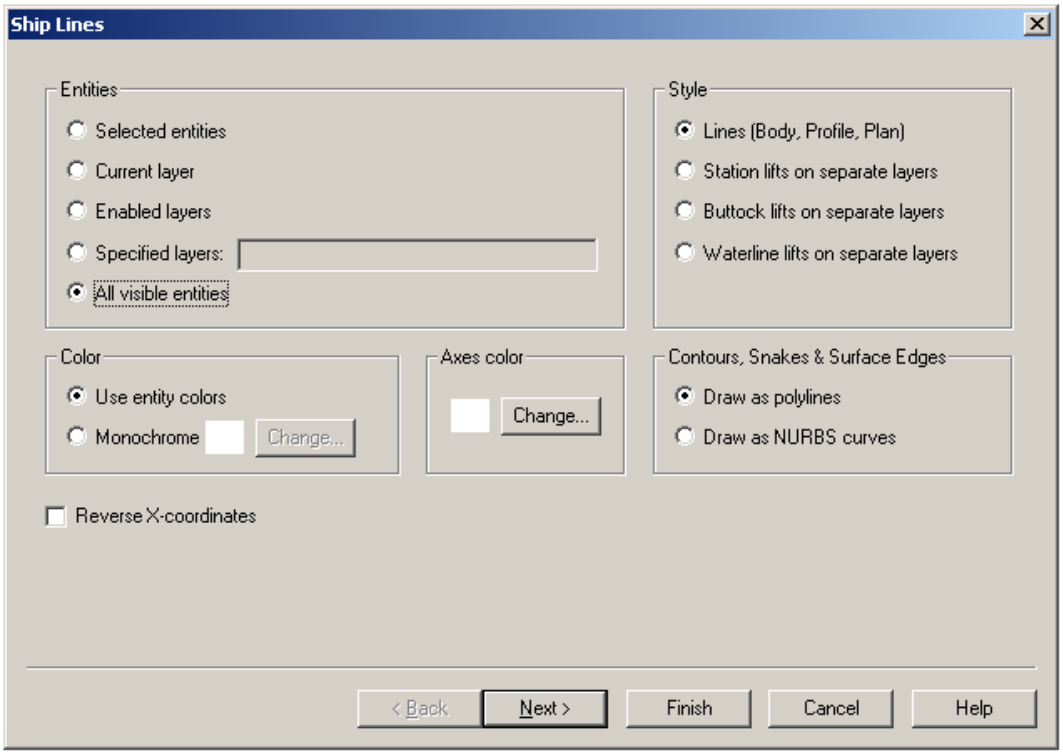
This allows the user to select whether or not he wants the X-coordinates in the model to be reversed (all x-values are multiplied by -1). This allows a model which is oriented with the bow at a lower X-position than the stern to be displayed in the ship lines view with the bow to the right since this view's X-axis is positive to the right. Default is unchecked.

Wizard Navigation

Next: Clicking this button removes this page and displays the next page in the wizard. Default values for options in the next page are calculated at this time (unless previous user specified values exist) based on the choices made in the first page.

Finish: Clicking this button terminates the wizard and displays the ship lines view. If the user has not visited the second page before clicking this button, any previous specified values for options on the second are used. If no such values exist, default ones are calculated and used instead. The values of all options are saved as attributes in the model.

Cancel: Clicking this button terminates the creation of the ship lines view.



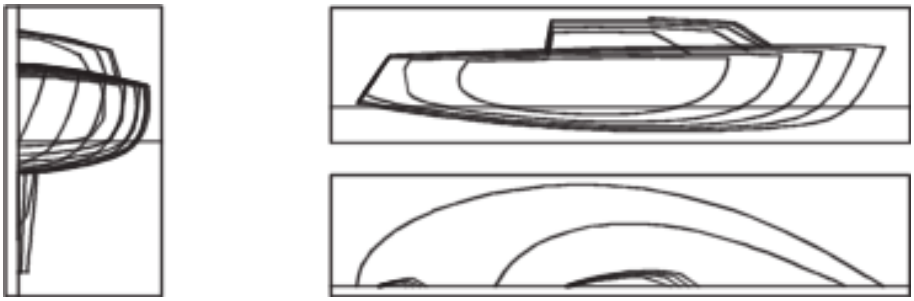
Style. *This list of options determines how the entities will be displayed. Each style has its own set of qualified entities that will be included in the drawing.*

1. *Lines (Body, Profile, Plan) (Default choice):* A traditional style lines plan consisting of a body, profile and plan view of the selected entities will be displayed. Qualified entities include snakes, surfaces, triangle meshes and composite surfaces.
2. *Station lifts on separate layers*: Station lifts are displayed. Qualified entities include Contours based on a transverse plane, and/or CvContours based on a line parallel to the X-axis. The reference to separate layers actually applies to any exported dxf file. Each individual cut of a contour entity is placed on its own layer in the dxf file. The layer is named by combining the contour's name with the X-position of the particular cut.
3. *Buttock lifts on separate layers*: Buttock lifts are displayed. Qualified entities include Contours based on a plane parallel to the Y=0 plane, and/or CvContours

based on a line parallel to the Y-axis. The reference to separate layers actually applies to any exported dxf file. Each individual cut of a contour entity is placed on its own layer in the dxf file. The layer is named by combining the contour's name with the Y-position of the particular cut.

4 *Waterline lifts on separate layers*: Waterline lifts are displayed. Qualified entities include Contours based on a plane parallel to the Z=0 plane, and/or CvContours based on a line parallel to the Z-axis. The reference to separate layers actually applies to any exported dxf file. Each individual cut of a contour entity is placed on its own layer in the dxf file. The layer is named by combining the contour's name with the Z-position of the particular cut.

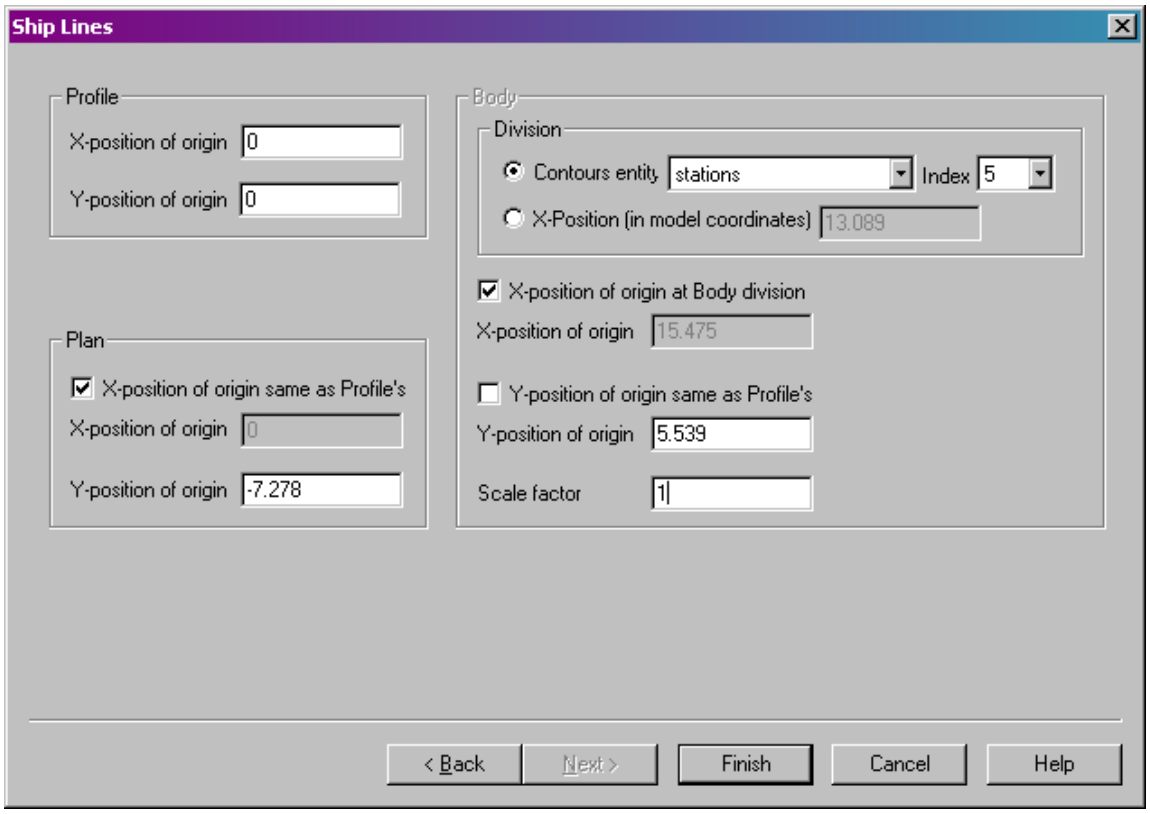
Usage of lift-style drawings: The sections-on-separate-layers format is a very handy form of drawing for CAD detailing. The separate layers can be individually detailed and turned on and off in various combinations for tracing and comparisons. Individual sections are also required for N/C cutting of bulkheads and frames. Lifts are often the starting point for making wood or foam half-models.



Line colors. Wireframe colors or monochrome (radio buttons); if monochrome, specify the color (by number). Program default is wireframe colors.

Note: If you change the model while a ship lines view of it is open, the ship lines view will automatically update.

Second page - Lines style selected



Profile

These options allow the user to select a position for the origin of the profile view relative to the drawing's origin.

X-position of origin (Default is 0.): The X-position of the profile view relative to the drawing's origin.

Y-position of origin (Default is 0.): The Y position of the profile view relative to the drawing's origin.

Plan

These options allow the user to select a position for the origin of the plan view relative to the drawing's origin.

X-position of origin same as Profile's (Default is checked): When checked, the origin of the plan view shares the same X-position as selected for the profile view. Checking this option also disables the text box for entering the X-position of the origin for the plan view and the value from the profile view is displayed in the box.

X-position of origin (Default is 0.): The X-position of the plan view relative to the drawing's origin. This is enabled only if the previous option is unchecked.

Y-position of origin (Default is calculated from size of drawing.): The Y position of the plan view relative to the drawing's origin.

Body

These options allow the user to select a position for the origin of the body view relative to the drawing's origin and at what X-position to split the sides of the view.

Division: These two options allow the user to specify at what location the user wants to split the body view. The default is to specify the X-position directly. As noted in parentheses this value is given according to the model's coordinates, **not** the drawing's coordinates. A default value is calculated based on the drawing's size. This text box is disabled if the other option is selected. The other option is to locate the split at a particular index of a contours entity. When selected, the user selects a contours entity and index from the two drop down boxes (these are disabled until this option is selected). Only contours entities that are parallel to the X=0 plane appear in the list of the first drop down. The list of indices that appears in the second drop down depends on the contours entity selected in the first.

X-position of origin at Body division (Default is checked): When checked, the X-position of the origin of the body view is at the same location where the split occurs along the profile view. Essentially, this means that the X-position of the origin is the sum of the X-position of the profile view's origin and the X-position of the body plan's division. This value is displayed in the disabled text box below.

X-position of origin: This text box is enabled only if the check box above it is unchecked. The user uses this box to directly enter a X-position for the origin of the body view relative to the drawing's origin.

Y-position of origin same as Profile's: When checked, the Y-position of the origin of the body view relative to the drawing's origin is the same as the one specified for the profile view. This value is displayed in the disabled text box below this option.

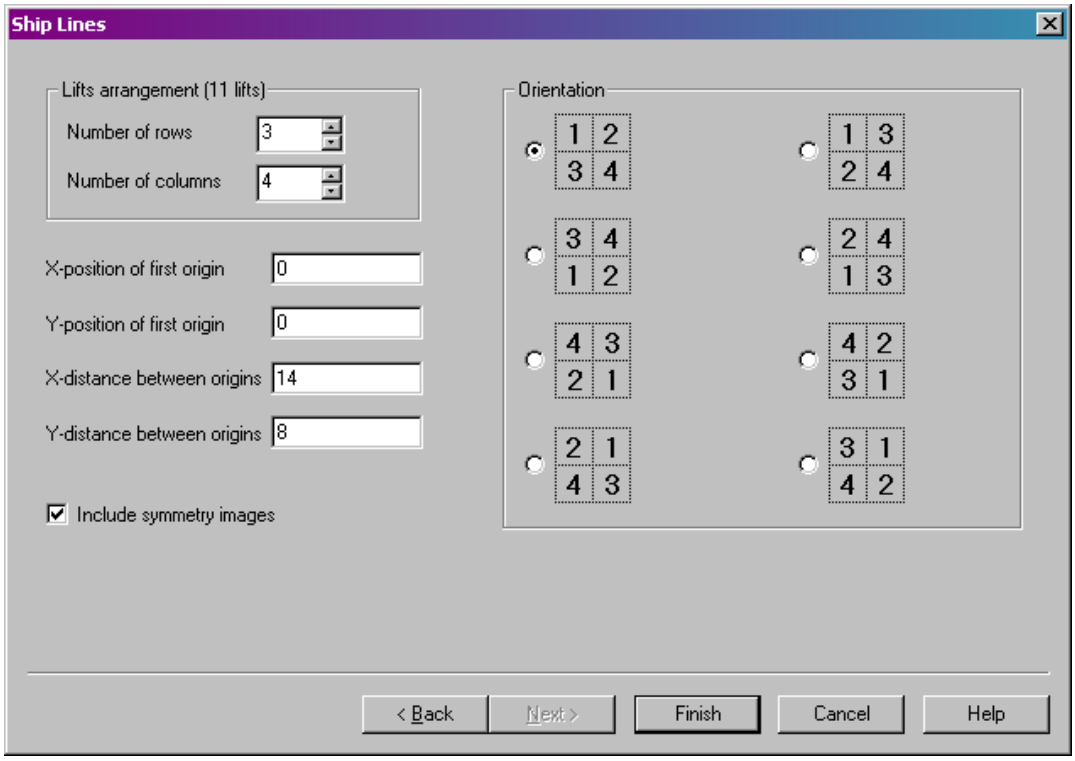
Y-position of origin: This text box is enabled only if the check box above it is unchecked. The user uses this box to directly enter a Y-position for the origin of the body view relative to the drawing's origin.

Scale factor: The user can enter a scale factor for the body view in this text box.

2D export

You can use **Right-click>Export DXF** to save the ship lines view as a 2D file.

Second page – Station, Buttock or Waterline Lifts style selected



Second Page Options

Number of rows (Default is 1): Specifies the number of rows of station/buttock/waterline lifts in the drawing. When rows and columns are both one, all the lifts share the same origin and are drawn on top of each other.

Number of columns (Default is 1): Specifies the number of columns of station/buttock/waterline lifts in the drawing.

X-position of first origin (Default is 0.): Specifies the X-position of the origin of the lift at the first row and column as indicated by the Orientation option selected.

Y-position of first origin (Default is 0.): Specifies the Y-position of the origin of the lift at the first row and column as indicated by the Orientation option selected.

X-distance between origins (Default is 0): The horizontal distance between the origins of lifts.

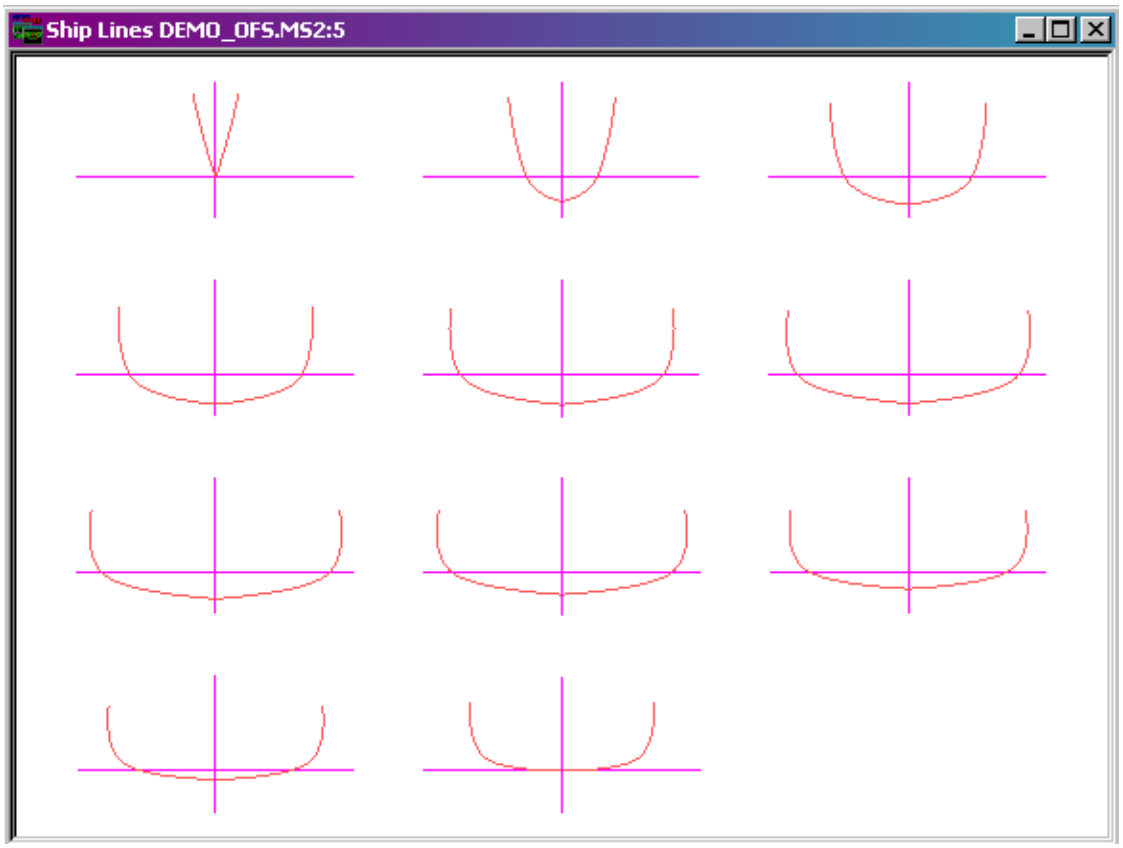
Y-distance between origins (Default is 0): The vertical distance between the origins of lifts.

Orientation: This list of options determines the order of placement of lifts on the drawing. The order is displayed for each option. For station lifts for example, the most forward lift is placed in the upper left hand corner. Each lift to the right is at a position further aft and each row is further aft than the row above it. The most

aft lift is the lower right hand position of the drawing. '

Include symmetry images (Default is checked): When checked, the symmetry images of entities are included in the drawing. This option does not appear with the buttock lifts style.

Station Lifts



New Commands

WAMIT Commands

Commands for import and export of IGDEF=1 GDF files for WAMIT

File.Export3D.GDF1 command

File.Export3D.GDF1 [filename[.ext] [tol [order]]]
 with the wetted surfaces selected.
Exports a WAMIT higher-order GDF file of B-spline
 surfaces (IGDEF=1).
tol has units of length; default = .0005 times model size.
 (* can be used for default tolerance.)

order = B-spline order; default = 4 (cubic).
(order can be specified as 0, to use exact NURBS data.)
(Special WAMIT authorization is required.)

ImportGDF1 command

ImportGDF1 filename[.ext] [kind]
Imports a WAMIT higher-order GDF file
in IGDEF = 1 format (B-spline surfaces).
kind = 0 (default) for light NURBS surfaces;
kind = 1 for points and NURBS surfaces.

Compound commands

Multiple commands can now be entered in the Command Window dialog, separated by semicolons. For example,
select ss1; solve
to select the entity named ss1 (a dormant SolveSet), *and* start the solution, with a single command.

LabelTrimesh command

LabelTriMesh [code]
with one Trimesh-class entity selected.
Creates TM magnets labeling nodes, links, and/or triangles with their numbers.
code is bitwise: 1 for nodes + 2 for links + 4 for triangles.

New Functions

AREA function

now handles CompSurf and TriMeshes, in addition to surfaces.

BBOX function

The BBOX function gets information about the bounding box of a single entity, or a set of entities specified by an Entity List. A bounding box is the smallest rectangular solid, aligned with the global coordinate system, that encloses the selected entities.

The BBOX function has four arguments:
1. Entity or Entity List
2. Real scale factor
3. Real sign
4. Index, 1 to 3 for X, Y, or Z component

Argument 4, index, selects which of the 3 coordinate values is returned. Argument 3, sign, controls which side of the bounding box is returned: if negative, the low side; if zero, the center; if positive, the high side. Argument 2 expands or contracts the box around its center.

Example: suppose curve6 extends from 1 to 5 in X, from -2 to 9 in Y, and from 0 to 0 in Z (it lies in the X-Y plane). Then:
BBOX(curve6, 1, 0, 1) = 3.00 (X coordinate of the center of the box)
BBOX(curve6, 1, -1, 2) = -2.00 (Y coordinate of the low-Y side of the box)

Errors:
559. BBOX function: No graphic objects.

BSPL function

The BSPL function evaluates the so-called "B-spline basis functions", which are the mathematical foundations of B-spline and NURBS curves and surfaces.

BSPL has five arguments:
1. KnotList, or *UNIFORM for uniformly spaced knots.
2. K, polynomial order (2 for linear, 3 for quadratic, 4 for cubic, etc.)
3. N, number of basis functions.
4. I, index indicating which basis function to evaluate (1 to N).
5. T, parameter (nominal range 0 to 1, but can be any real value)

Example: BSPL(*UNIFORM, 3, 5, 2, 0.40) returns 0.3200
In this case the knots are uniform (0, 0, 0, 1/3, 2/3, 1, 1, 1); the B-splines are quadratic (K = 3); there are N = 5 of them; I = 2 selects the second basis function; T is 0.40.

Errors:

222. NURB has too few knots for its order and number of control points.

223. NURB has too many knots for its order and number of control points.

234. Insufficient spacing between knots.

556. BSPL function: order less than 1.

557. BSPL function: number of basis functions less than 1.

558. BSPL function: index is out of range (1 to number of basis functions).

Layer Names in the Status Bar

When there is enough room on the status bar the current layer indicator pane now expands in length and shows the layer name as well as the number. If there is not enough room, typically because a long message is being displayed, the pane shrinks in length and only displays the layer number. When shrunken, the layer name is displayed in a tooltip when the mouse cursor hovers over the pane.

Real Values Dialog Enhancement

In the case of a Variable displayed in a Real Values Dialog, direct editing of that value is now available. No longer does the value need to be changed in the Properties Manager, but can be edited directly in the Real Values Dialog.

Expanded Multiple Edit

With a selection set of tab entities, Multiple Edit now allows the user to change the data file of all Tab Entities with one edit.

Tab Entity Relative Path

There is now a choice at the end of browsing for a file, when OK is pressed in the File/Open dialog. This will have a set of 2 buttons:

Relative path
Absolute path

If the user chooses "Absolute path", there is no change from the current functionality. The new option is to calculate the relative path, and use that.

This option is only presented when the browsed file and the .ms2 file are on the same drive. (When the drives are different, there is no relative path.)

New Trimmed Surface Triangles

No. of triangles = 0 option
If the number of triangles is specified as 0, it uses the Trimmed Surface divisions and subdivisions to calculate the number of triangles wanted, and uses NU/NV for aspect ratio.

"Star Naming"

Star Naming allows the user to create names which continue a previously established naming convention. An example would be if a pattern of surface names were established with names 'cabinsurf1', 'cabinsurf2'… the user would not need to remember the next number in the series. During the modeling process a fifth surface created for the cabin would be named 'cabinsurf*', which would result in a name of 'cabinsurf5'.

Updated Example Files

The sample files for all entity types have been updated to reflect the current best practices. Nearly every model contains embedded text (using the new Text Label entity type) to help explain the major point the model illustrates. These new files are located at the default location of:

C:\Program Files\AeroHydro\MultiSurf7\Examples. Please have a look!

DXF Export Enhancements

DXF Export of Trimmed Surface Boundary

The boundary is now broken into multiple polylines, one for each bounding snake. (Previous output was one polyline for each complete boundary loop.)

DXF Export of TriMesh Boundary

The boundary is now broken into separate polylines at any boundary breakpoint nodes. (Previous output was one polyline for each complete boundary loop.)

DXF Export as Lines

If a polyline would have only 2 vertices, write a LINE instead of a POLYLINE.

Latest Crypkey

The copyright protection software, Crypkey, has been updated to the latest version.