

Advanced Sweep Techniques

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Premium Partners:

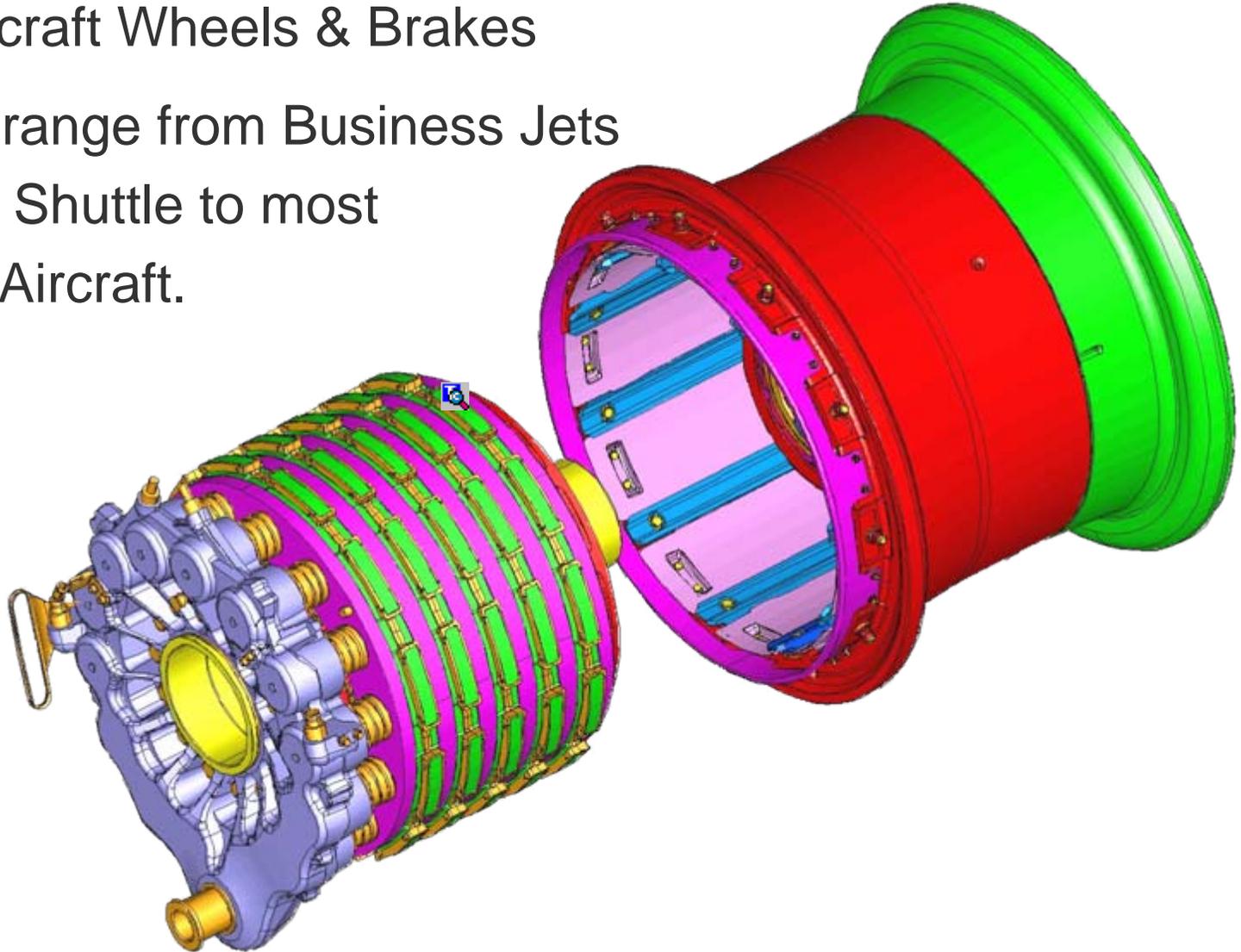


Microsoft

Advanced Sweep Techniques

Goodrich Aircraft Wheels & Brakes

Applications range from Business Jets to the Space Shuttle to most Commercial Aircraft.



Advanced Sweep Techniques

Agenda

- Background
- Goals
- 3d Spline Creation & Modification
- Variational Sweep is Your Friend
- This session will use slides and live demonstrations.

Advanced Sweep Techniques Background

- Sweep techniques needed for cable design on electric brakes for the Boeing 787.
- All prior commercial aircraft brakes are hydraulically actuated.



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Goals

- Learn the various ways to define a 3d spline and the ramifications of each.
- Learn methods to modify an existing 3d spline.
- To create a smooth looking flexible conduit.

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3d Spline Creation Methods

Uncontrolled or Semi-Controlled

- This is a method where the 3d spline is created in the context of the assembly where it will be used.
- There are two variations on this method, On-the-Fly and Named Part.

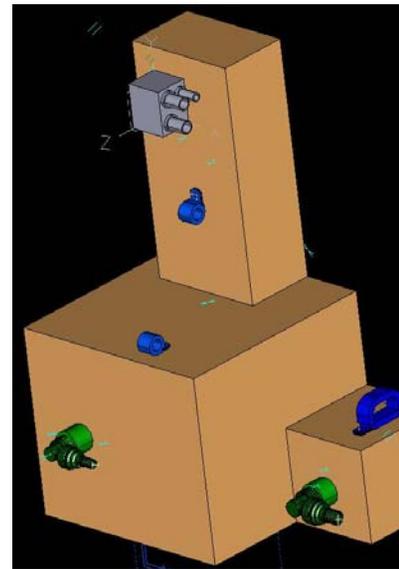
Controllable Reference Points

- This method involves creating a stand-alone part using offset reference points to drive the spline.

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Uncontrolled Spline Creation- On the Fly

- In Master Assembly hide all non-essential parts.
- Switch to Master Modeler application.
- Select the 3d Spline button.
- Pick your path points. After the last point hit MMB (Done).
- The Spline Options panel is displayed.



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Uncontrolled Spline Creation- On the Fly

- Initial Tangency Options

- Start only
- End only
- Start & End
- All 3
- NO Interior Points only



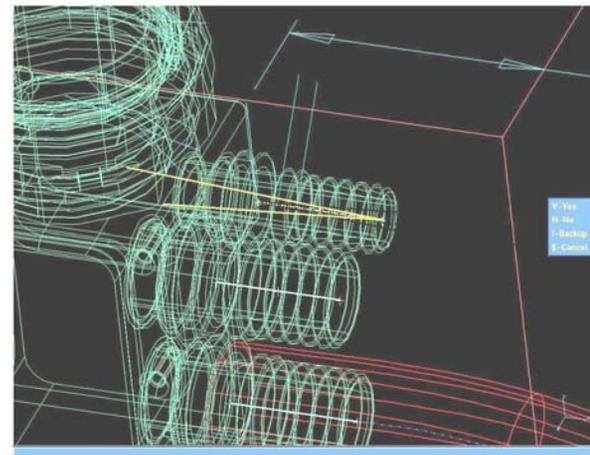
- Constraints

- Through Points
- Both options
- NO Tangency only

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Uncontrolled Spline Creation- On the Fly

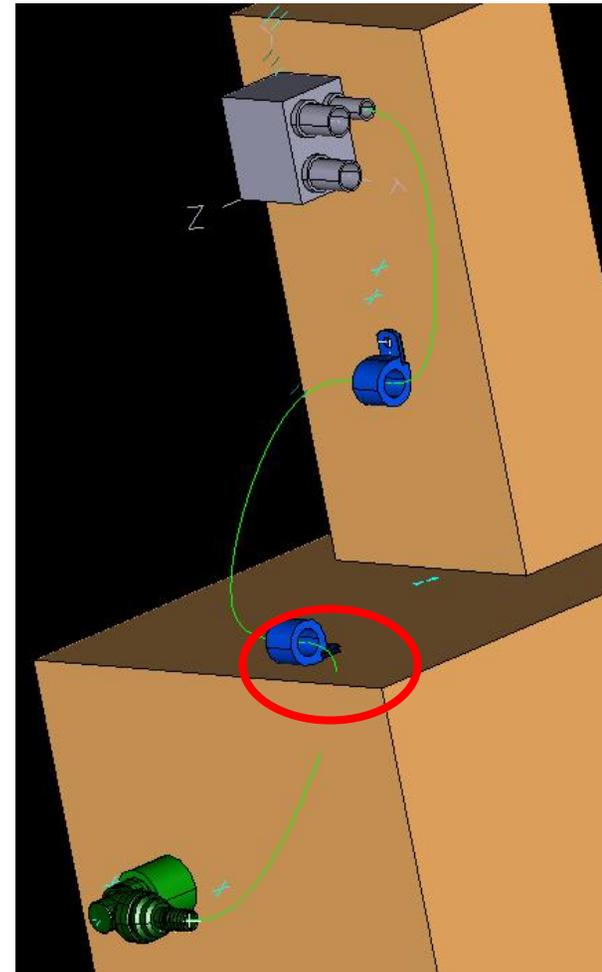
- I recommend choosing Start Point and End Point from the Initial Tangency Options column.
- Choose nothing from the Constraints column.
- Define the two tangency conditions.



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Uncontrolled Spline Creation- On the Fly

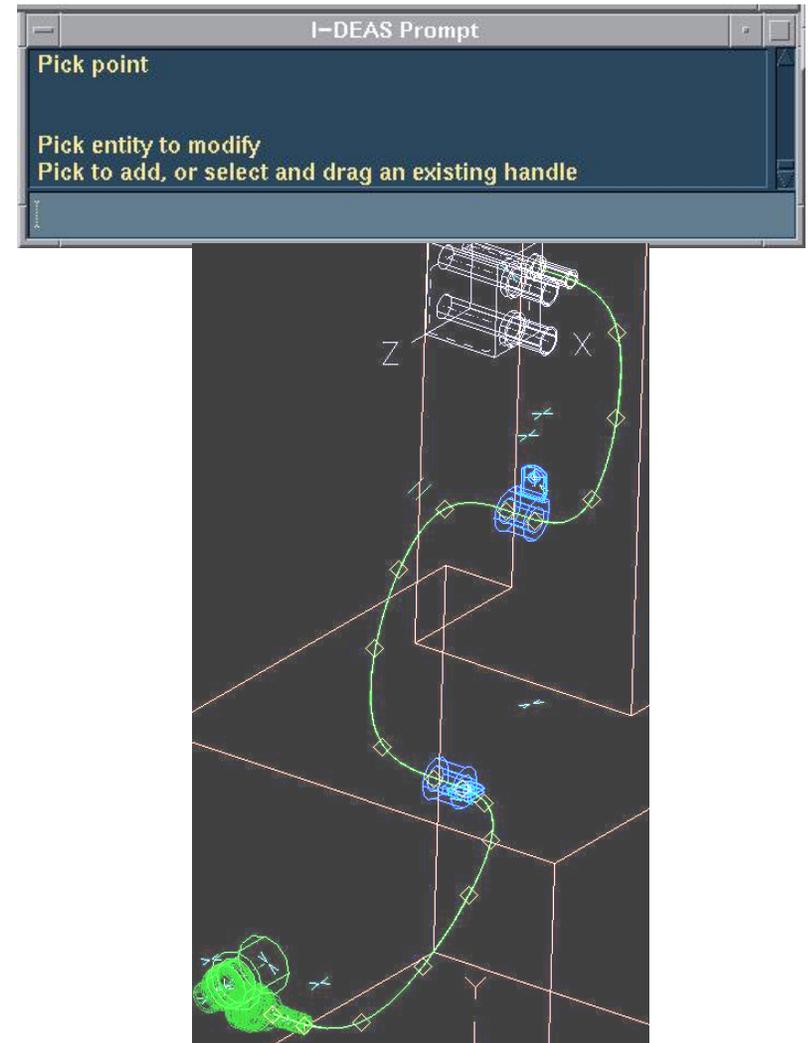
- The resulting spline.
- Notice the interference with the lower part of the block.



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Uncontrolled Spline Creation- On the Fly

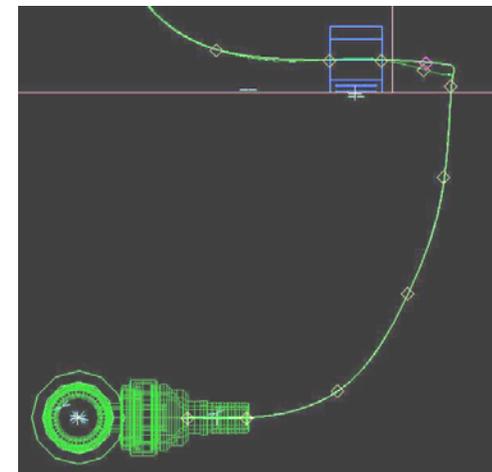
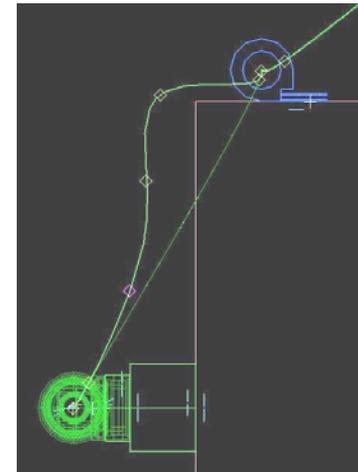
- Modify the spline.
- Add extra control points.
 - After hitting Modify and selecting the spline hit RMB, Add to insert extra control points.
 - Control points allow dragging the spline.



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Uncontrolled Spline Creation- On the Fly

- Control points drag in the plane of the viewing screen.
- Screen shows original path and new path.



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Variational Sweep

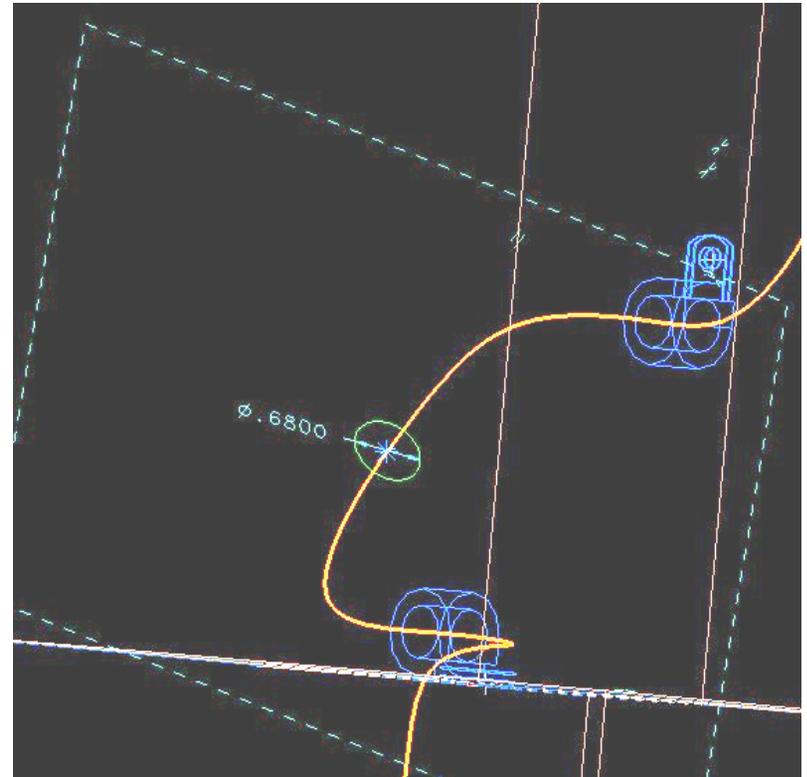
- Variational Sweep is a two step process.
- Select the Sketch on Path icon
- Select your spline
- The path and section will highlight.
- Select any spot along the path to get a perpendicular sketch plane.



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Variational Sweep

- Create a circle centered at the point along the spline and modify the diameter as required.



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Variational Sweep

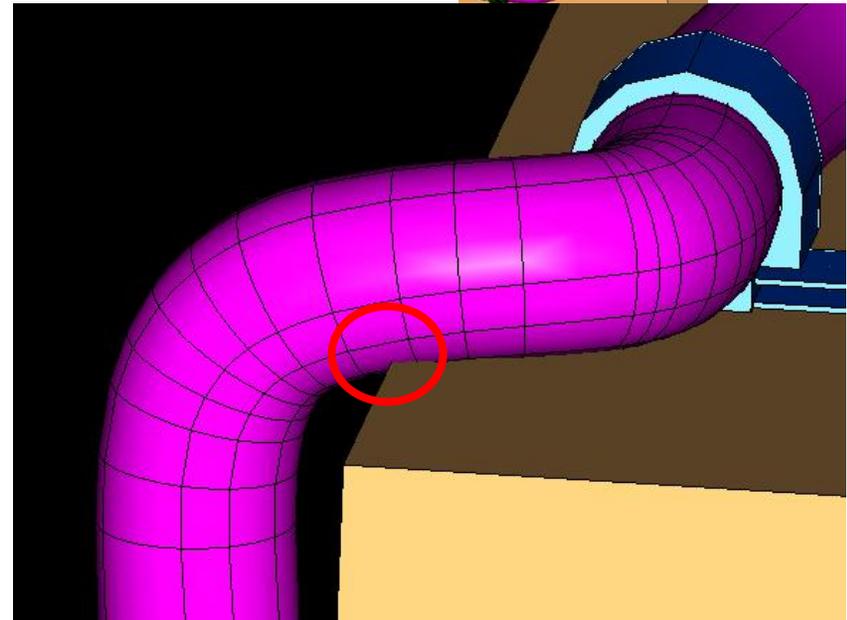
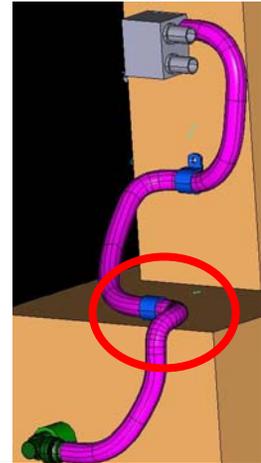
- Hit the Variational Sweep icon (under the Extrude stack)
- Select the circle.
- The Create Surface panel will display.
- Make sure Endcaps and New Part are checked on and hit OK.



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Variational Sweep

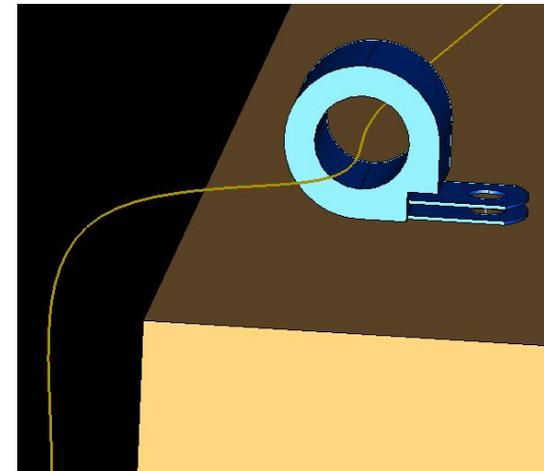
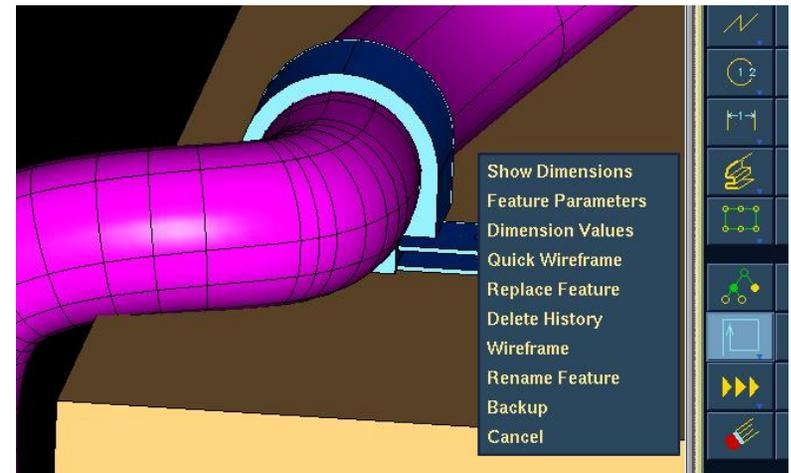
- The cable is now created.
- A Modification is required due to a clearance issue.



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Modifying the Cable

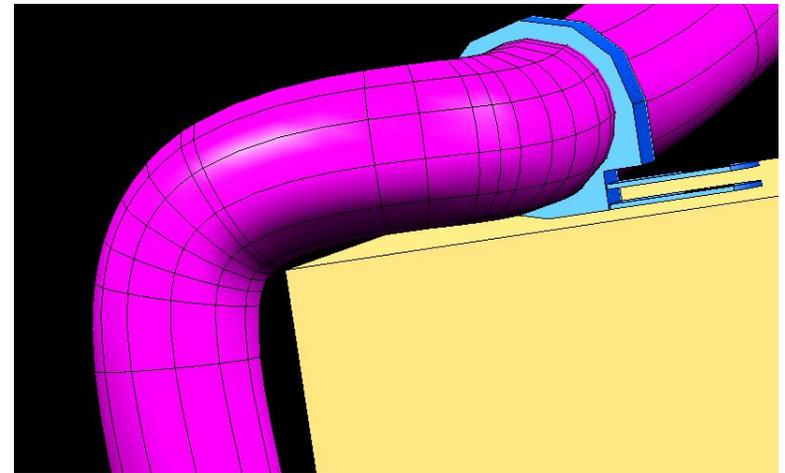
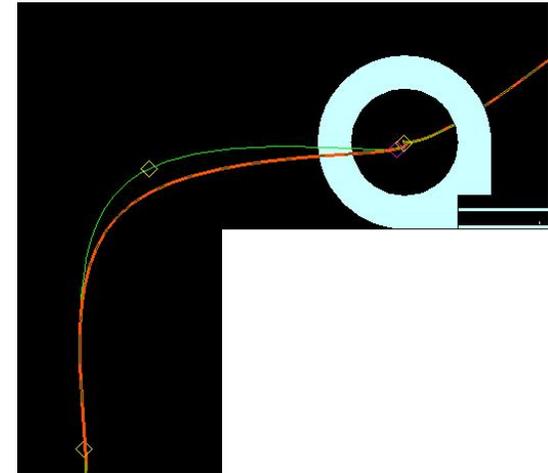
- Select the Modify icon.
- Select the cable.
- Select Wireframe from the shown menu.
- The section of the path will be provided.



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Modifying the Cable

- While in Modify mode, select the section and then Reconsider.
- The underlying wireframe curve with the control points is displayed.
- Drag points around as needed and then update.
- The cable now clears the corner.



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Adding the Cable to Assembly

- The last step is done in Master Assembly to add the cable to the hierarchy.
- Don't put any constraints on the cable within the assembly.

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Uncontrolled Spline Creation- Named Part

- An alternative to the On the Fly method is to:
 - Create a new part in Master Modeler
 - Put the part away
 - Go to Master Assembly & get out your assembly
 - Add your new part to the assembly & constrain as needed.
 - Switch to Master Modeler
 - Sketch In Place on the coordinate system of the new part.
 - Create 3d spline and Variable Sweep as before

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Uncontrolled Spline Creation- Named Part

- Advantage to this method
 - You can completely delete and recreate your cable without losing your part name & number

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Wrap-up

- Less equals more. Looser controls give better control.
- Variable Sweep is easier to use than Sweep.
- I never intend for my cables to be a true finished item for manufacturing. These are just representations to put in an assembly.
- You can do an Info Measure to get the curve length of the centerline to get a fairly accurate length for the cable.

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Wrap-up

- If you have concerns about minimum bend radius then put in sections of true curves with specified radii and intermediate sections using the previously outlined method.

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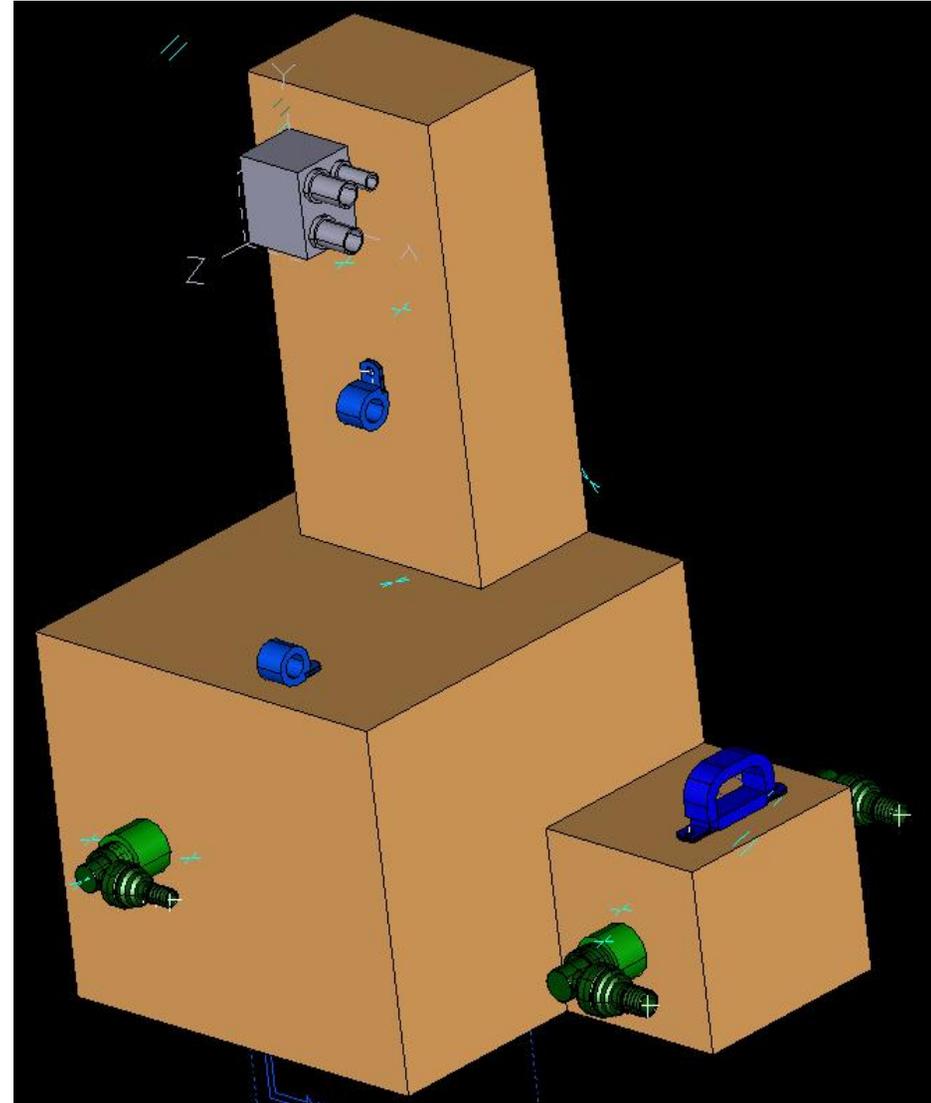
Controllable Reference Points

- A 3rd Method (NOT RECOMMENDED!!!)
- Create new part to be the cable.
- Create offset reference points.
- Points represent all known points which cable passes through.
- Create 3d spline through points.

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Controllable Reference Points (contd.)

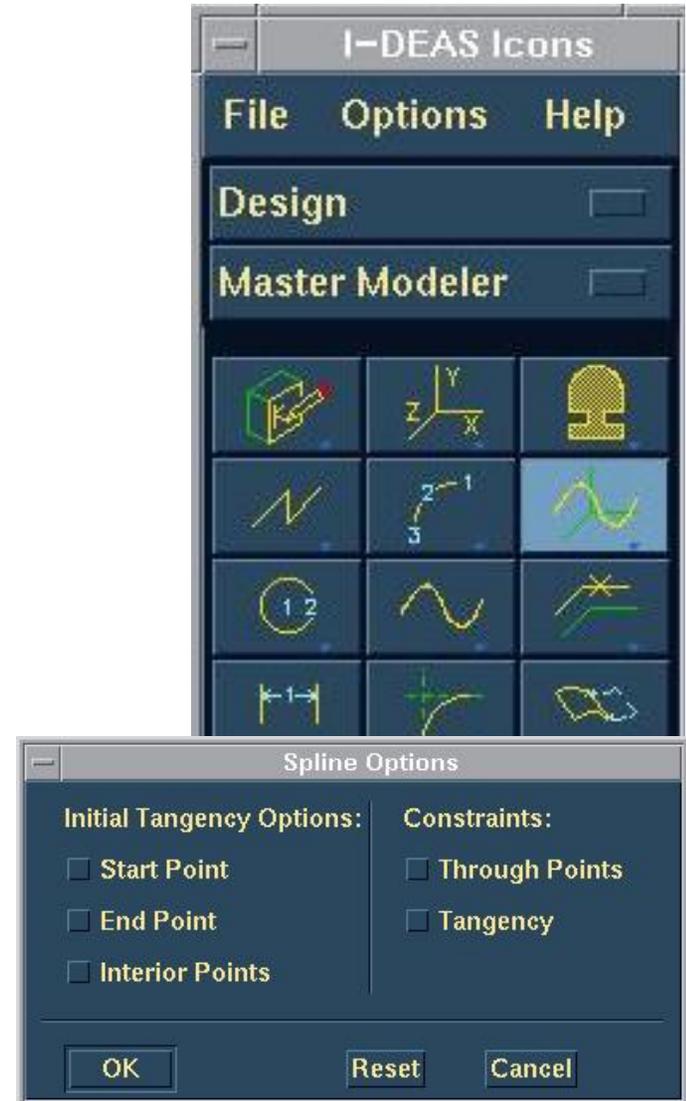
- The conduit will go from the small port on the gray box through the 2 small clamps and to the fitting on the lower front of the assy.
- 8 hard points, 2 at each end and 2 at each clamp



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Controllable Reference Points (contd.)

- Create a part with reference points at all locations needed to define and control the spline.
- The next step will be to create the 3d spline.
- Select the 3d Spline command
- Pick the points that were just created.
- After selection the Spline Options form is displayed.



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Fully Constrained Spline

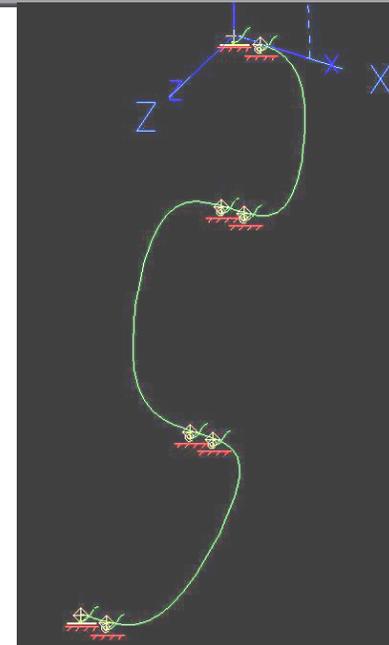
- This is the result of a fully controlled spline.
- The results are pretty bad.
- I strongly recommend that you NEVER use the spline options with all options turned on.



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Mostly Constrained Spline

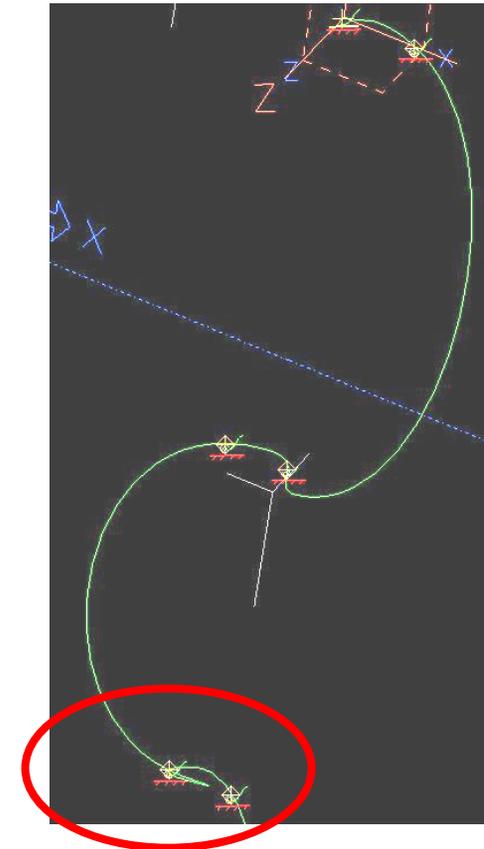
- The next trial will be with the Interior Points tangency turned off.
- The results are much better than the previous trial with the options on.
- This is the very close to the same spline that was obtained in the original unconstrained method.



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Mostly Constrained Spline

- Simulate a change in the base part.
- Move 3rd pair of points vertically.
- Notice the results in the right picture.
- NEVER use the reference point method of spline creation.



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Mostly Constrained Spline

- Creation of the spline through modifiable reference points seemed like a good idea at first but:
 - Identification of the points is very time consuming
 - Modification of the spline is very difficult and rarely gives the results desired.