How To: Converting a parasolid (water tight) into plane slices with automatically calculated data points for the sliced profile.

Purpose: To be used by 3D CAD K12 students to convert their freeform aircraft fuselage model into an importable \*.dat file format for aircraft modeling software such as VSP and XFLR5.

Current Situation: Students can generate sliced profiles but have to generate the \*.dat file by visual interpolation using some type of a grid overlay.

Discussion: I am a retired technical person and am trying to create a 4 or 5 session program to teach K12 students, that are very 3D CAD capable, the interwoven fabric of various engineering disciplines so they have a much better idea of the kind of engineering studies would be of interest to them when they enter university level education. One of my backgrounds is Aero Engineering. Therefore, with the local emphasis on Aerospace Engineering, I thought it would be a good idea to try to re-energize our younger generation in the area of General Aviation, specifically Light sport Aircraft. This is a bit like the Real   
World Design Challenge (PTC) except that in this case the students really get to be involved in actually designing a LSA. The problem is that VSP and XFLR5 were based on using a typical airplane fuselage model (circular cross-sections) and them pulling on the cross-sections to create some arbitrary shape that is similar to their model. This is crude and a bit backward for advanced 3D CAD students. I believe that a better approach would be to let the students design their freeform fuselage shape and then convert that shape into planar slices (appropriately scaled). These planar slices can be input to VSP and XFLR5. Then the wings, etc., can be added in that program (what these programs excel at doing).

Creating the planar slices is relatively easy. Extracting the profile data for the planar slices is a different matter. My preferred approach would be to convert the freeform watertight solid body into a \*.3dm nurb based file. Then, do the planar slicing. The planar slices are numbered and may not necessarily be equally spaced. The reason for not equally spacing the slices is because of minimizing the amount of slice data and being allowed to select critical points along the fuselage where the slices are the most important, especially at inflection point junctions on the model.

Once the planar slices are created, the next step is to extract the profile data. Again, as noted in the previous paragraph, inflection points in the profile are critical to maintaining the profile shape when importing to VSP and XFLR5. Ideally, it would be great if the profile can first have its inflection points identified (if there are any) and then the decision made as to how many discrete points are to be calculated to properly model the profile. There are two choices as to where to place the profile points. I would prefer that the choice is grid based or angular slice based. For example, if I want each half of the profile to have 50 points, I should be able to select the grid so it is variable in the X and y direction. The axis of the aircraft fuselage has already been identified earlier when it was a solid model. The XY grid origin is fixed on the axis and I should be allowed to have different X and Y scaling of the grid. In addition, with inflection points, I might want to create a uniform grid between inflection points based on an angular rotation between successive profile grid points between any two inflection points.

It needs to be kept in mind that at some point, the fuselage and remaining parts of the aircraft will be tessellated. The degree of tessellation can be varied to emphasize the need for greater computational accuracy in particular locations on the aircraft.

I have stated to the VSP.org group (Rob McDonald and Mark Moore) that their geometry input is not consistent with 3D CAD procedures. Their comment to me was that any 10 year old can create a fuselage in their program so, what is my problem. Our 3D CAD students want to be able to create sophisticated models and move/import/export them between various types of software applications. I am not a 3D CAD expert, I am only trying to find a way to bridge between two application areas that apparently did not talk to each other during their development process.

Thank you for considering this request for assistance. I can be reached at [kadrmas@hiwaay.net](mailto:kadrmas@hiwaay.net) or 256-527-7001. I am near Huntsville, AL. I would like to put this 4 or 5 session program and try it out in a local high school. It the project is successful, it is free to anyone else that would like to try it out. Again, Thank you for considering.