To: Carleton University BWB UAV Project

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No. of Pages: 3

Subject: Peregrine 1 Catia Modelling Practices

Details:

This technical memo describes recommended procedures for development of the Peregrine 1 Catia model and includes proposals for best practices in CAD modelling. This document will also be the basis for a Standard Work guide for Catiav5 modelling.

Body Construction Using Boolean Operations

The easiest way to construct a hollow wingskin is to use the Shell command. Unfortunately, due to the small radius at the trailing edge of the wing and the fuselage, this leads to local degeneration of the surfaces – the attempted solution self-intersects.

Alternatively, Boolean operations can be used to delete the common volume between two intersecting solids. To complete this operation, another solid must be constructed that will be the void within the true platform OML.

Using a series of planes constructed at intervals laterally from the global frame, the profile of the platform can be replicated, at a negative offset. To do this, on each plane use the *Offset* command, select the full OML, and designate a thickness inwards. Please see the Parameterization section for advice on how to make this easily editable in the future. These profiles can be chained using *Multi-Sections Surface* in the *Generative Shape Design* workbench.

Surfaces can be made into a solid using *Close Surface* in the Part Design workbench. One restriction is that open profiles must be planar. For example, in Figure 6 the two open profiles are at the wing root and winglet. Both open profiles are ‘planar’ and could theoretically be closed with a single flat surface. If this is not possible, the profile of that face must be specified with a surface, which must be Connex (topologically connected to the others).

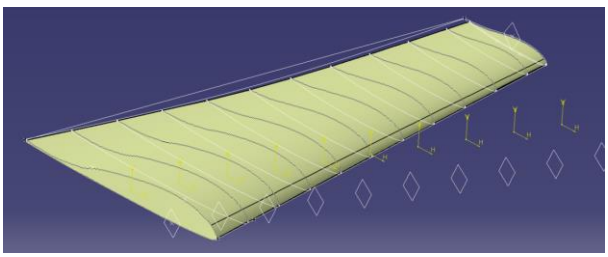

Figure 1: Replicated OML geometry offset inwards

Boolean operations are operations that take one PartBody, called the tool, and uses its characteristics to alter another PartBody, called the target. Types of Boolean operations include, but are not limited to, *Add*, *Remove*, *Union*, and *Assemble*.

For this operation on our platform, it is desired for the inner solid to be removed from the larger solid, using *Remove*. A new PartBody can be inserted into the CATpart file by selecting 'insert->Body'. Move the interior Close Surface operation into the newly created PartBody before attempting to perform the *Subtract* operation.

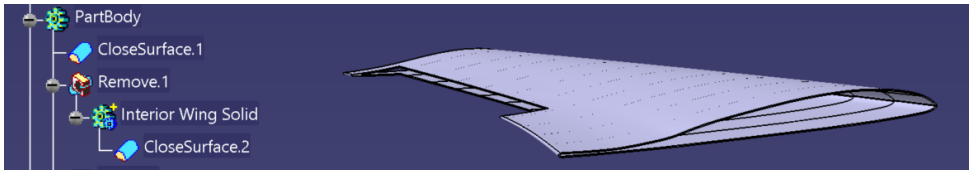

Figure 2: Specification tree for Remove operation between two close surfaces

Parameterization

Parameterization can be implemented to make variable parameters easy to change. For example, the offset profiles used to make the interior close surfaces are set to the desired thickness of the wingskin. If changes need to be made to the wingskin thickness, each one of these profiles would need to be altered to the new specification. Instead, a variable is set called 'Wingskin_Thickness' and each of these offset dimensions are set to be equal to this variable.

To make a variable, select 'Tools->Formula…'. In the formulas window, select 'New Parameter of Type'. Next, choose a descriptive name for the parameter and set a value. Click Apply.

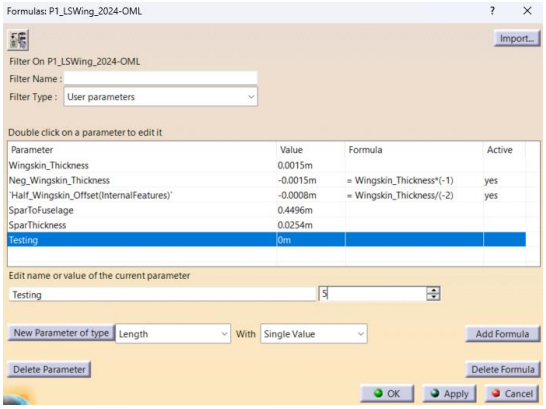

Figure 3: Formula command window for variable creation

Some parameters are related to already existing parameters or geometry. To set the value of a parameter to be equal to a formula, create a new parameter and click 'Add Formula'.

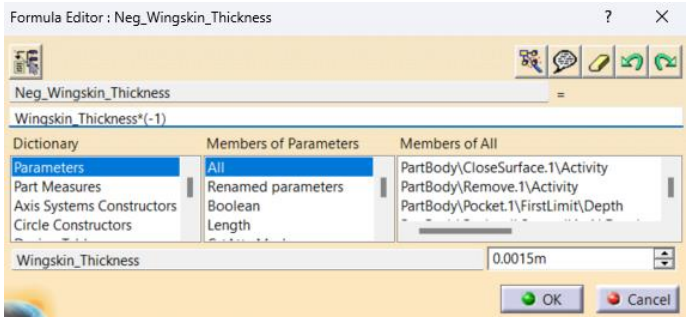

Figure 4: Formula editor window for variable formulas

When designing the P1 OML, implement parameterization for values that are expected to change. For example, the position of the spars is currently constructed via a plane that is a variable distance from the centerline of the fuselage. The thickness of the spar is set by a plane which is a variable distance from the first spar plane. Using this design methodology along with appropriate referencing to OML geometry, the size and position of the spar can be changed by changing their respective variables, and the spar will automatically reconstruct to fit the new space.

Catia Best Practices

Below is an itemized list of design practices that will make iterating on the master Catiav5 model easier, will allow future teams to recognize the design process used in previous year. Following these suggestions are imperative for the future development of models for the BWB UAV capstone.

1. For every part that requires a geometric reference to the profile of the OML (spars, wings, elevons, etc), import the geometrical set for the original P1 surfaces and the geometrical set for the surface mending. Reference these internal components when a feature depends on the OML.
2. Avoid at all costs referencing geometry from different CATpart files.
3. Get familiar with geometrical sets and part bodies, understand what their limitations are, and use them liberally to keep the specification tree organized.
4. Chain operations in a part body as little times as possible. If a feature uses more than 10 operations in series, there is likely an easier solution. Get familiar with the parents and children tree to recognize when the construction method of a component is too complicated.
5. Keep a master CAD folder for the assembly and parts of the current recognized master design. Keep working files separate, in descriptively named and dated folders. Once a design in a working folder has been approved for release, implement it on the master assembly, and save the new configuration under a new folder using the ‘send to’ option. This tells you all files that are linked to this geometry.