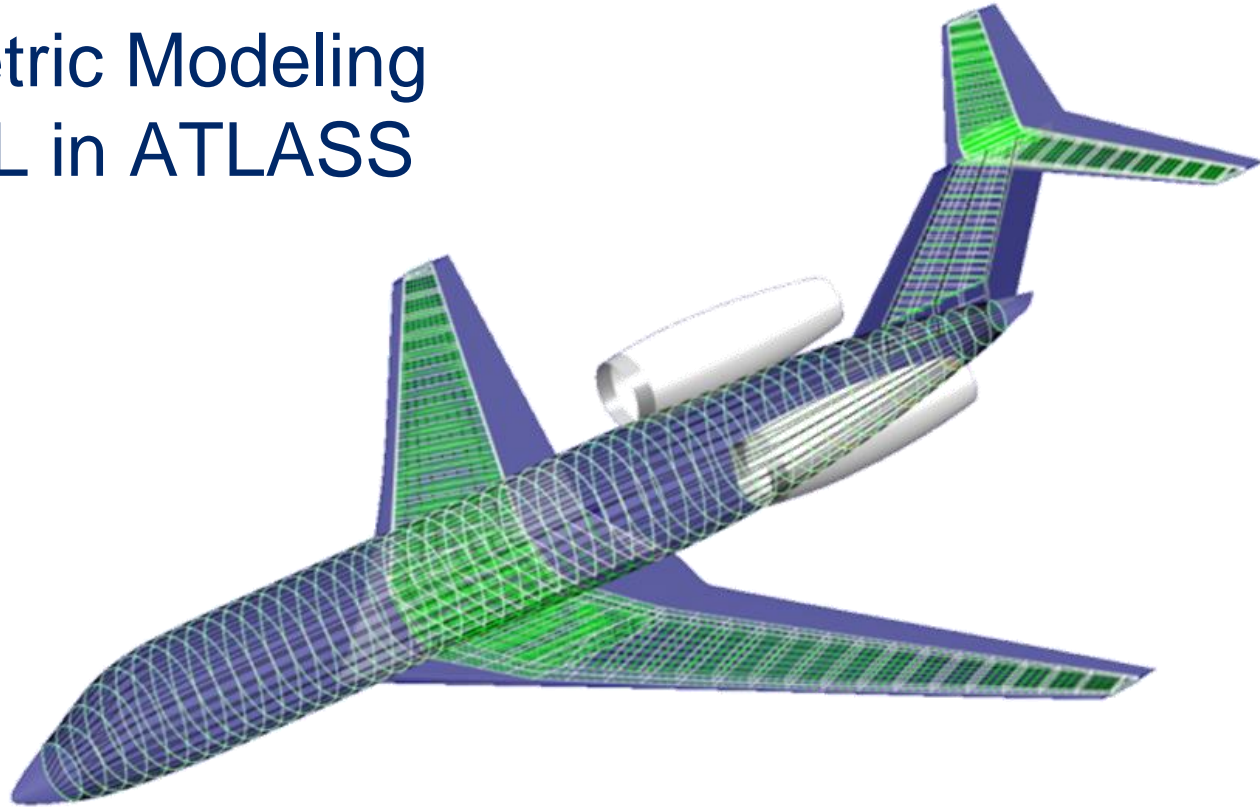


ASMI Rotation - Parametric Modeling and EKL in ATLASS



Vishank Battar

04/24/2019

Overview

- Introduction
- Parametric Modeling
- Engineering Knowledge Language
- Questions



Introduction - About me

Where I'm from and what I love!

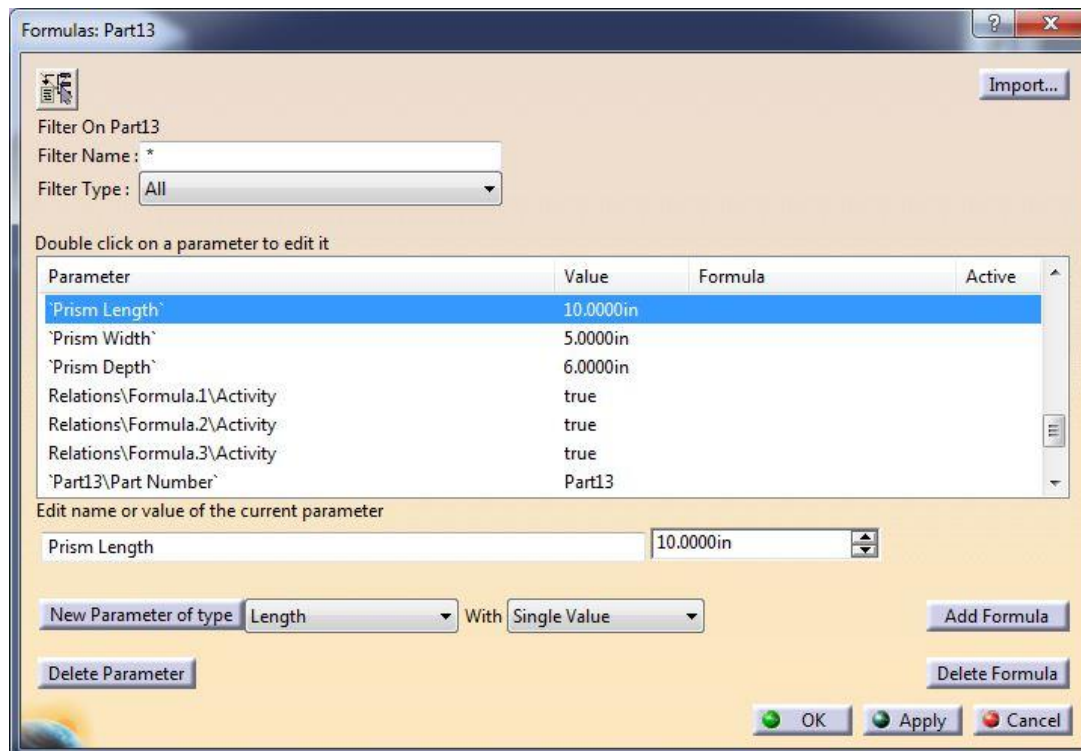


Parametric Modeling - What is Parametric Modeling?

- Properties of Design are defined by changeable parameters

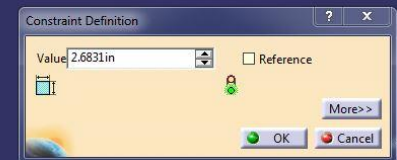
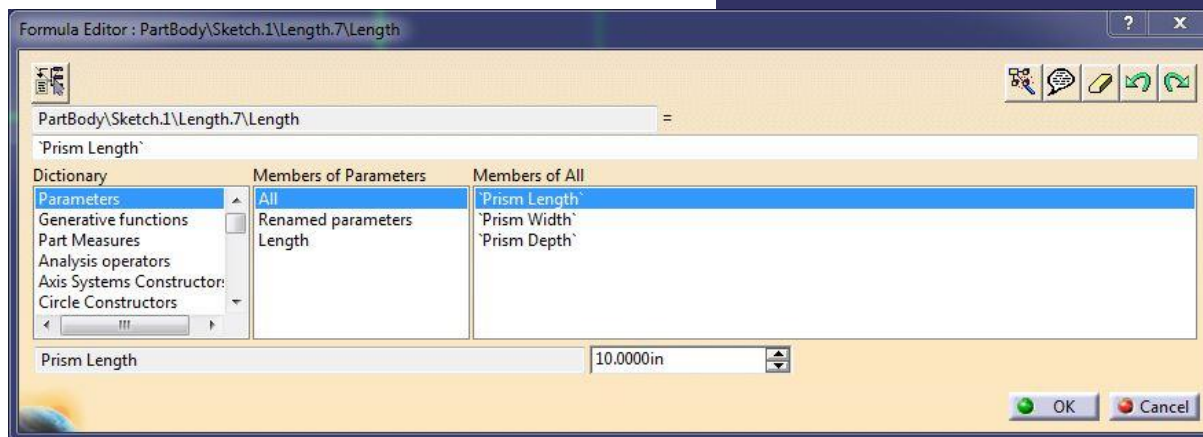
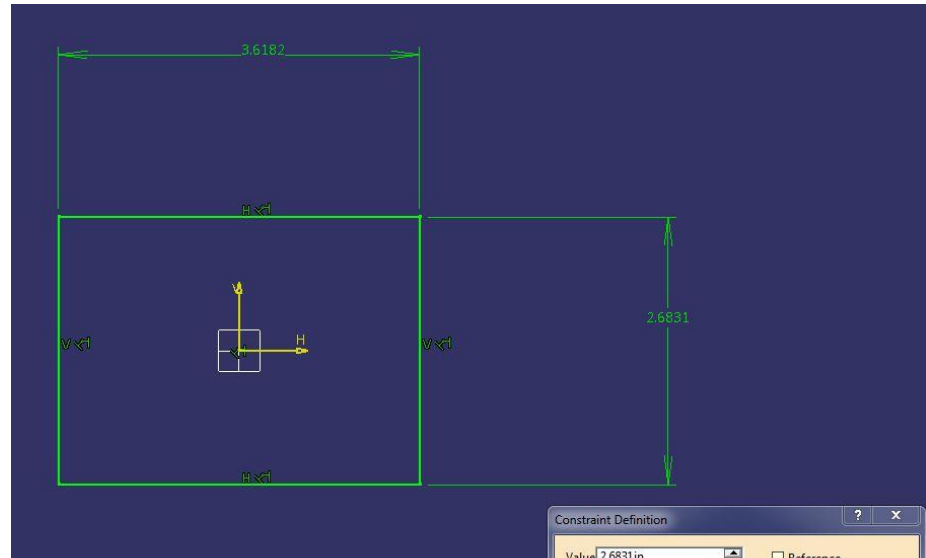
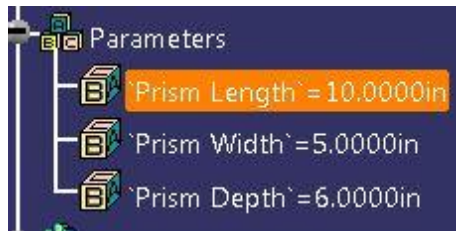


← Knowledge Workbench



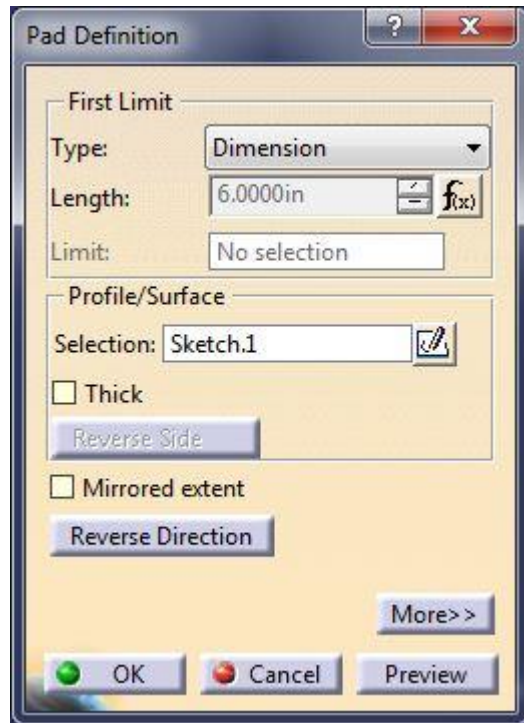
Parametric Modeling - Linking Design Constraints to Parameters

- Constraints can be defined by formulas set equal to parameter values



Parametric Modeling - Linking Design Constraints to Parameters

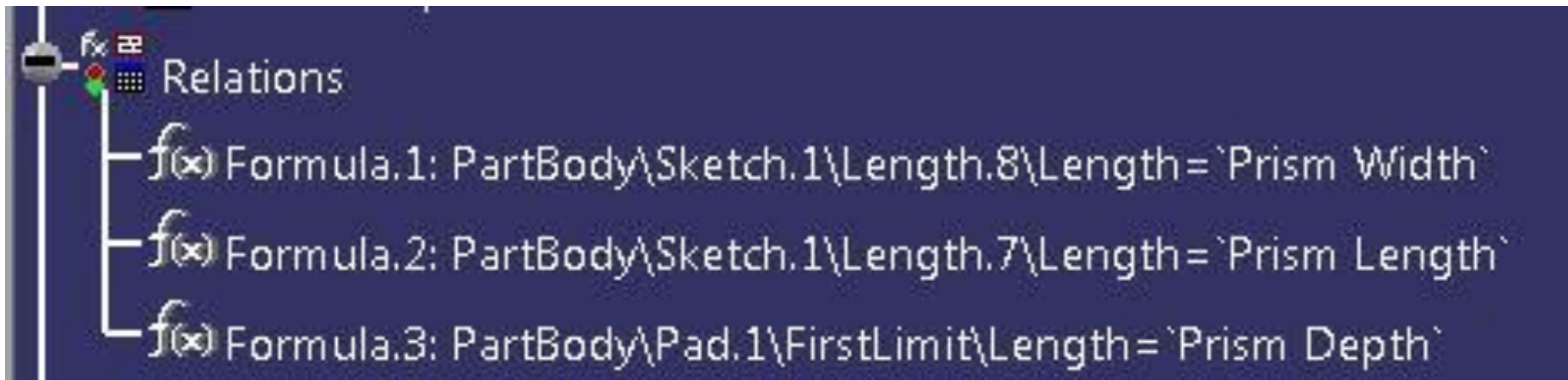
- Constraints can be defined by formulas set equal to parameter values



← An indicator that this constraint was defined with a formula

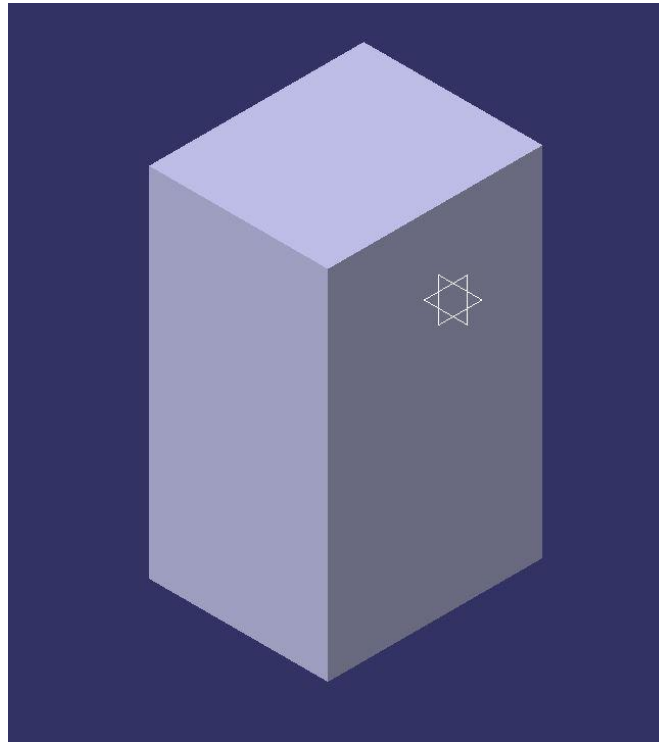
Parametric Modeling - Relations Folder

- All formulas are stored in the relations folder



Parametric Modeling - Final Product

- The final product is the same, but changing the design becomes much easier



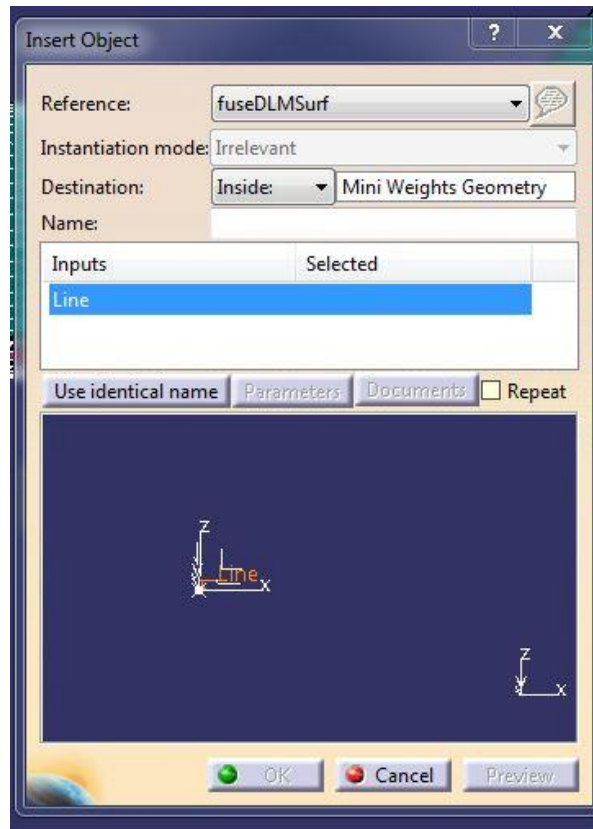
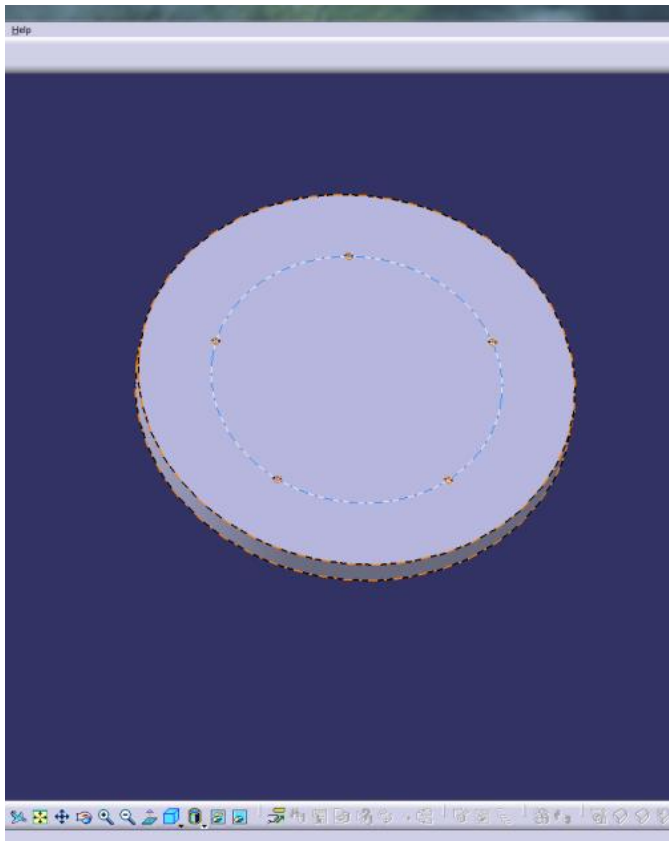
User Defined Features (UDFs) and Knowledge Patterns

- User Defined Features are Packaged Sets of Geometry
E.g. a sphere, a rivet, a spar, etc.
- Knowledge Patterns are pieces of code that help automate the design process

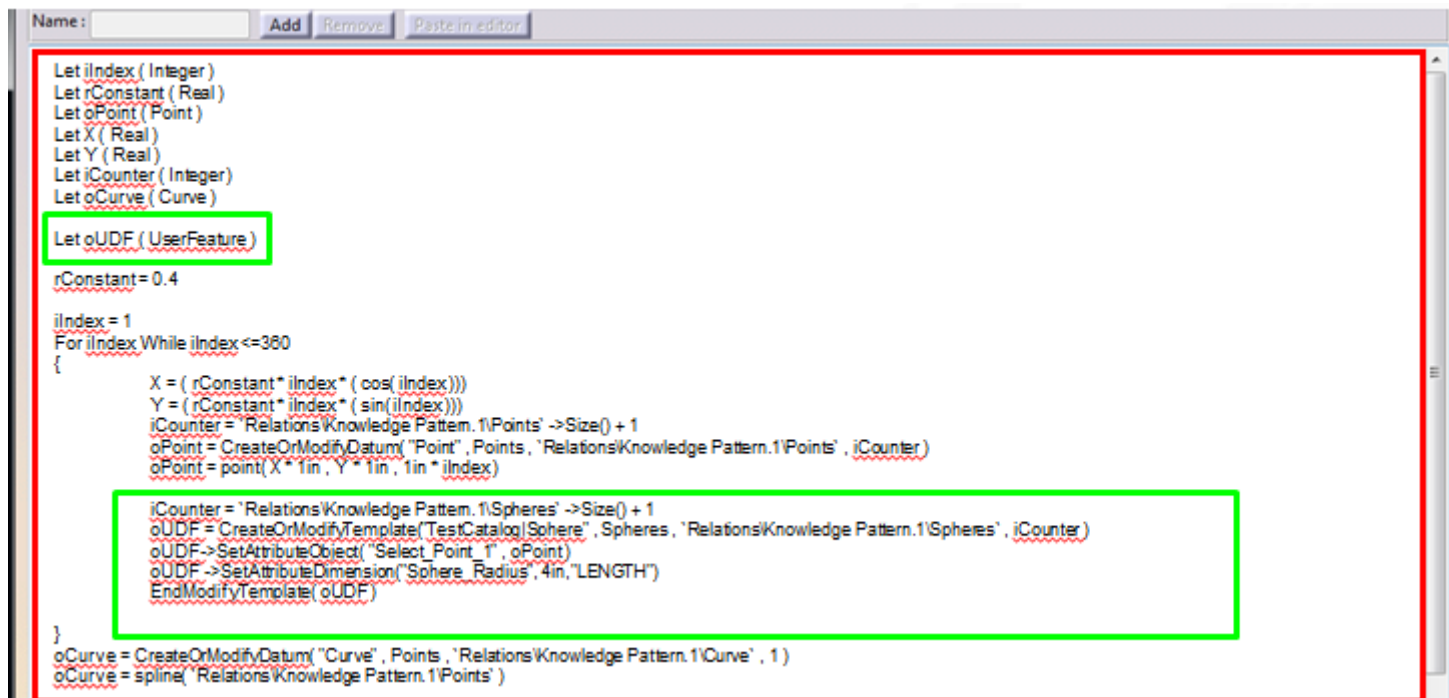


Training - User Defined Features (UDFs)

- UDFs can be instantiated manually



Training - User Defined Features (UDFs)



```
Name:  Add Remove Paste in editor

Let iIndex ( Integer )
Let rConstant ( Real )
Let oPoint ( Point )
Let X ( Real )
Let Y ( Real )
Let iCounter ( Integer )
Let oCurve ( Curve )

Let oUDF ( UserFeature )

rConstant = 0.4

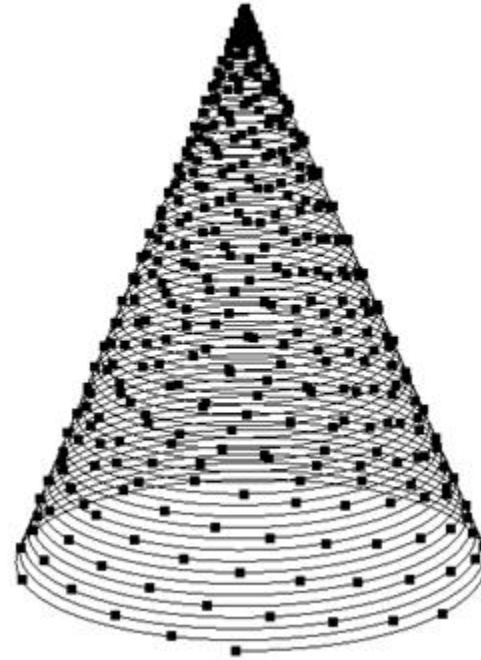
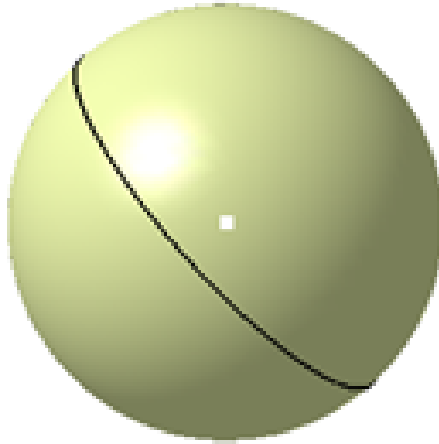
iIndex = 1
For iIndex While iIndex <= 360
{
    X = ( rConstant * iIndex * ( cos( iIndex ) ) )
    Y = ( rConstant * iIndex * ( sin( iIndex ) ) )
    iCounter = 'Relations\Knowledge Pattern.1\Points' -> Size() + 1
    oPoint = CreateOrModifyDatum( "Point", Points, 'Relations\Knowledge Pattern.1\Points', iCounter )
    oPoint = point( X * 1in, Y * 1in, 1in * iIndex )

    iCounter = 'Relations\Knowledge Pattern.1\Spheres' -> Size() + 1
    oUDF = CreateOrModifyTemplate( "TestCatalog\Sphere", Spheres, 'Relations\Knowledge Pattern.1\Spheres', iCounter )
    oUDF -> SetAttributeObject( "Select_Point_1", oPoint )
    oUDF -> SetAttributeDimension( "Sphere_Radius", 4in, "LENGTH" )
    EndModifyTemplate( oUDF )
}

oCurve = CreateOrModifyDatum( "Curve", Points, 'Relations\Knowledge Pattern.1\Curve', 1 )
oCurve = spline( 'Relations\Knowledge Pattern.1\Points' )
```

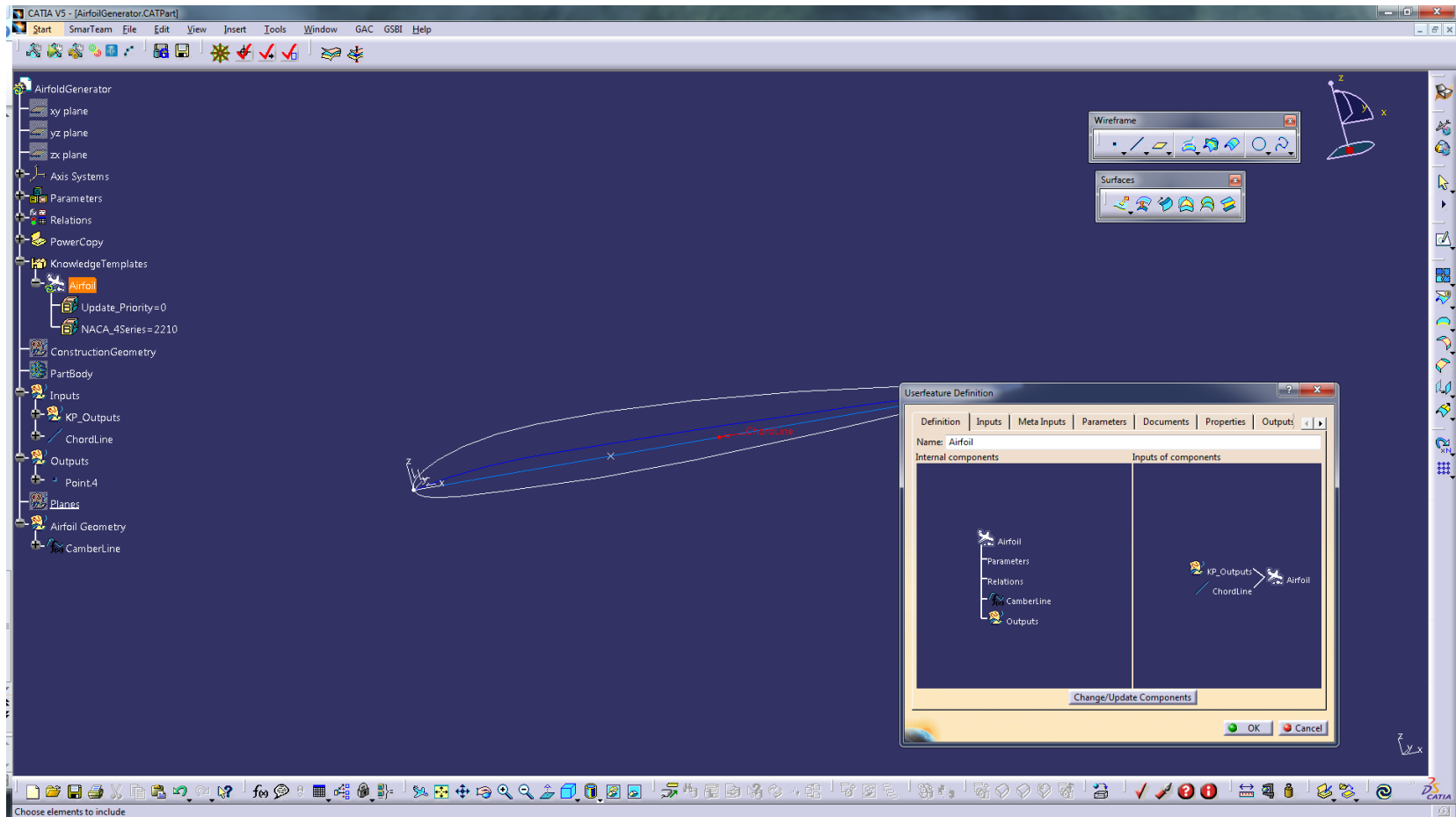
- UDFs can also be instantiated with the use of a knowledge pattern

Training - User Defined Features (UDFs)



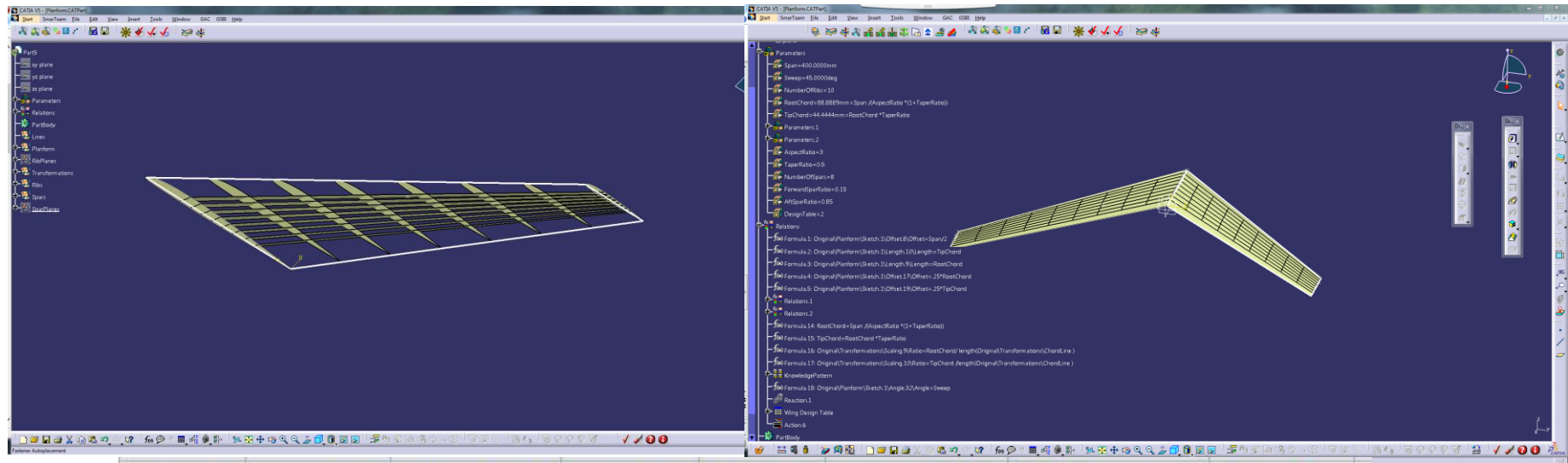
- UDFs can also be instantiated with the use of a knowledge pattern

Training - Putting a Knowledge Pattern Inside of a UDF



- Knowledge pattern outputs can also be put into UDFs

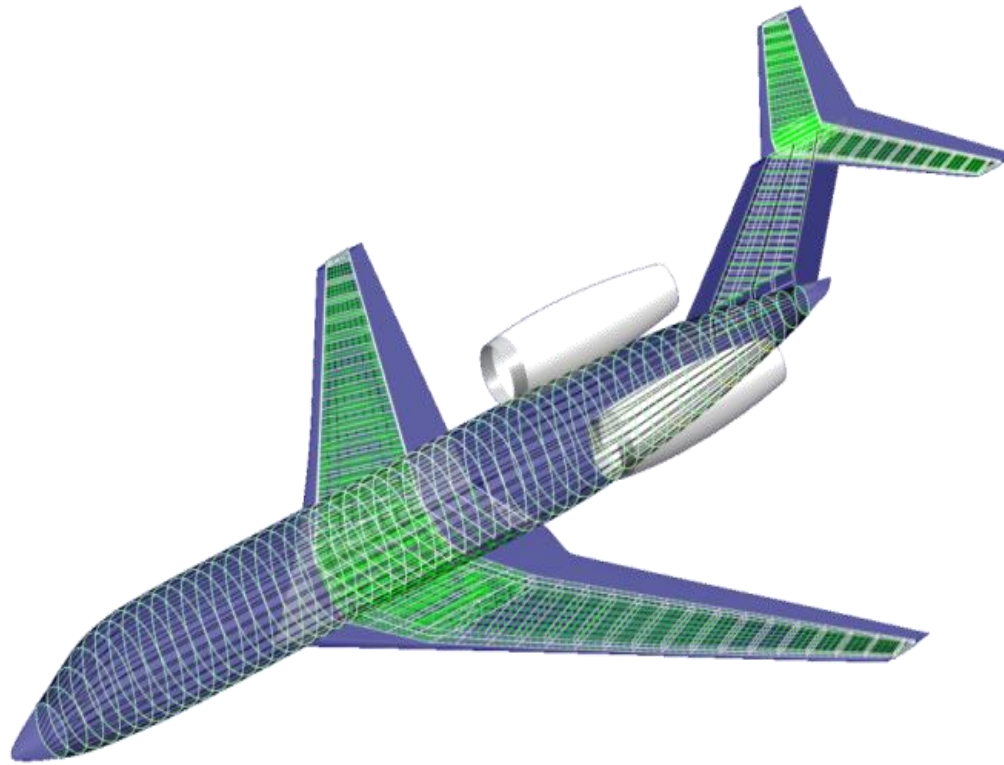
Training - Final Outcome



Span (mm)	Sweep (deg)	NumberOfRibs	AspectRatio	TaperRatio	NumberOfSpars	ForwardSparRatio	AftSparRatio
400	25	10	3	0.5	8	0.15	0.85
400	45	10	3	0.5	8	0.15	0.85
400	25	6	3	0.5	8	0.15	0.85
400	25	10	5	0.5	8	0.15	0.85
400	25	10	3	0.3	8	0.15	0.85
400	25	10	3	0.5	12	0.15	0.85
400	25	10	3	0.5	8	0.25	0.85
400	25	10	3	0.5	8	0.15	0.75

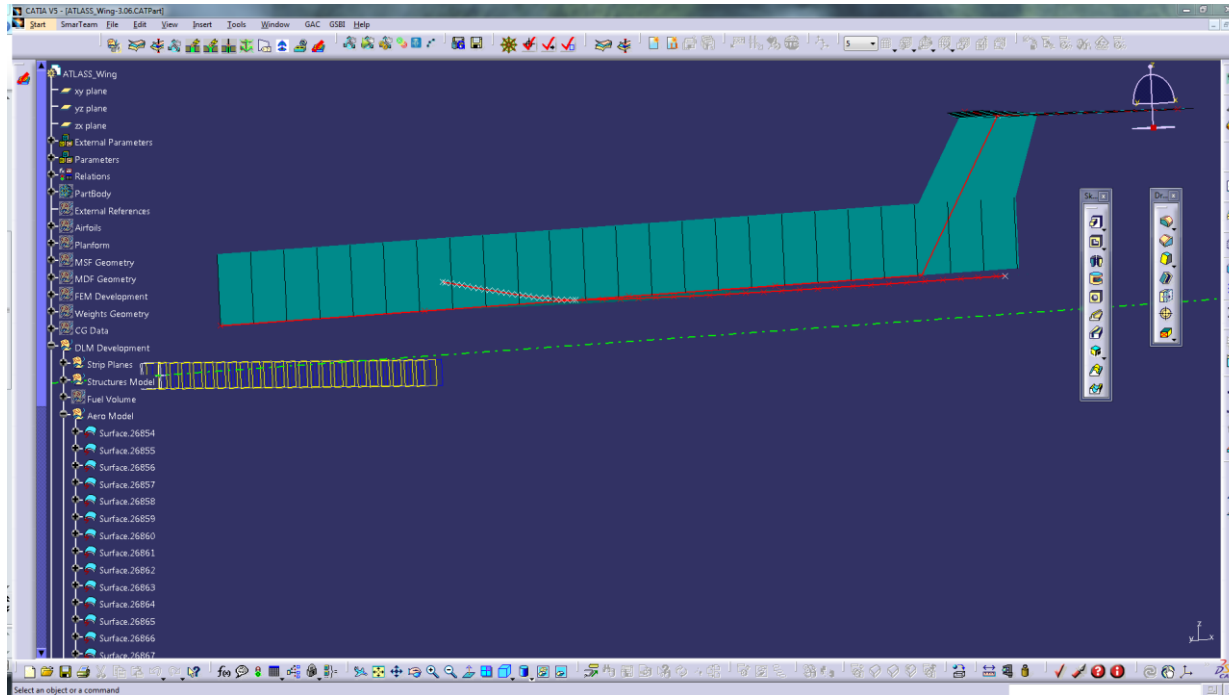
- Used knowledge patterns and UDFs to create parameter-based wing design

Automated Top Level Aircraft Structural Sizing Tool (ATLASS) - Overview



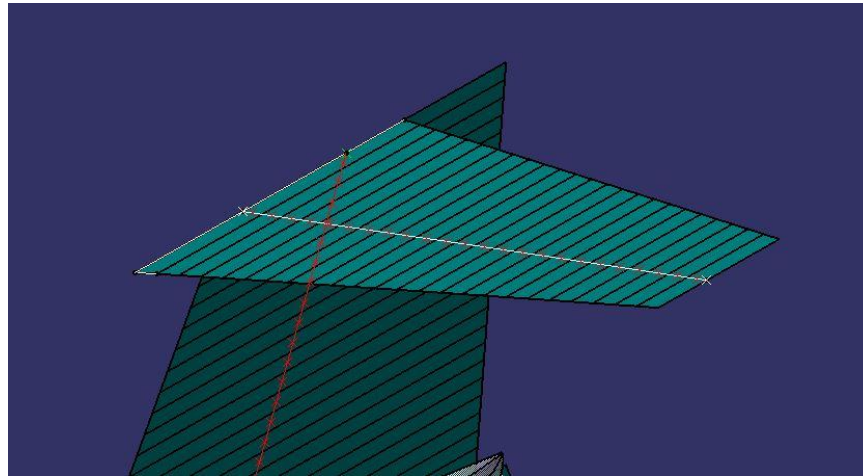
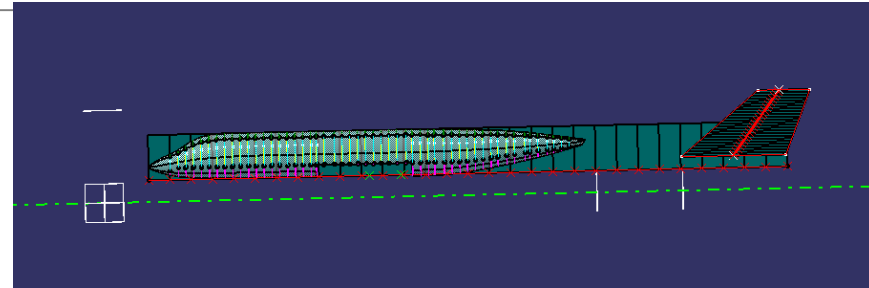
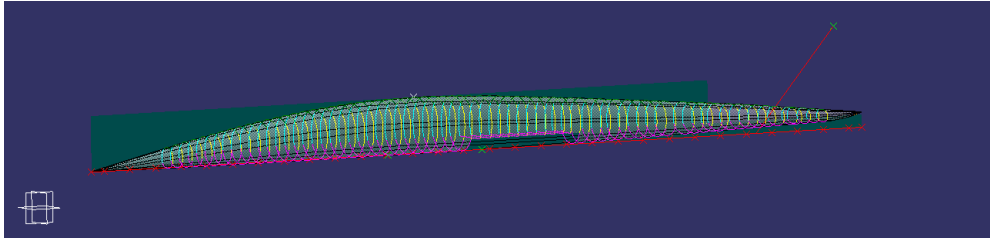
- ATLASS is a weight optimization tool that bridges the gap between preliminary design and detailed design

Fuselage Doublet Lattice Model (DLM)



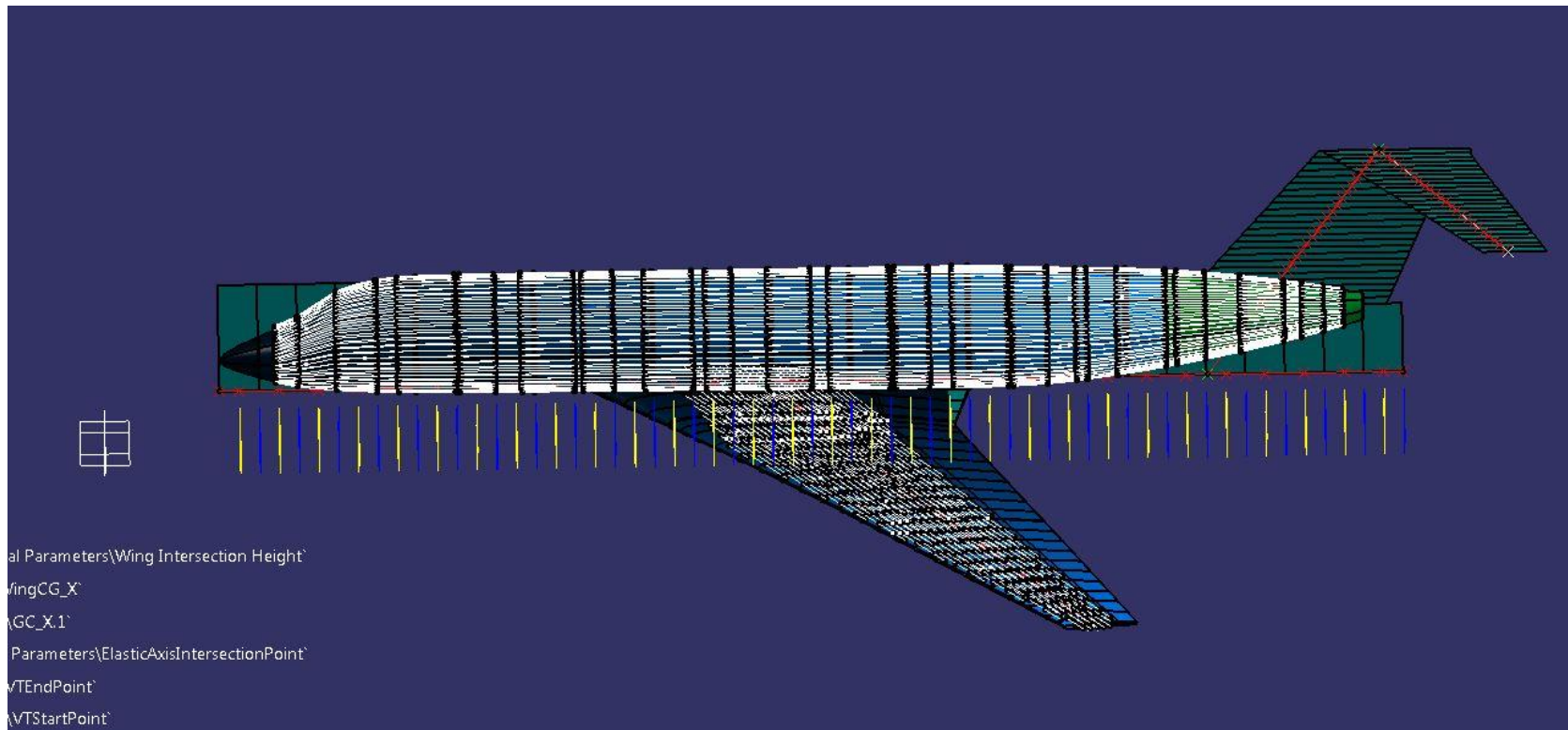
- Creates Panelized weights to be used in determining aerodynamic loads
- Initially used UDFs, switched to creating geometry entirely from code for consistency with other parts of plane

Fuselage DLM (continued)



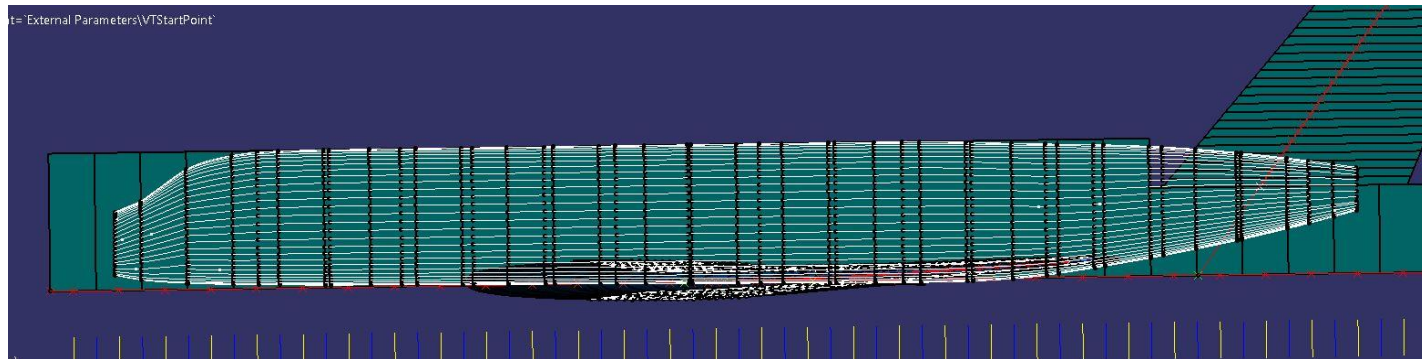
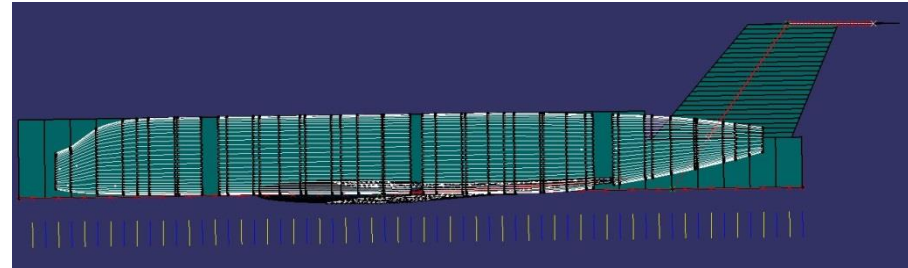
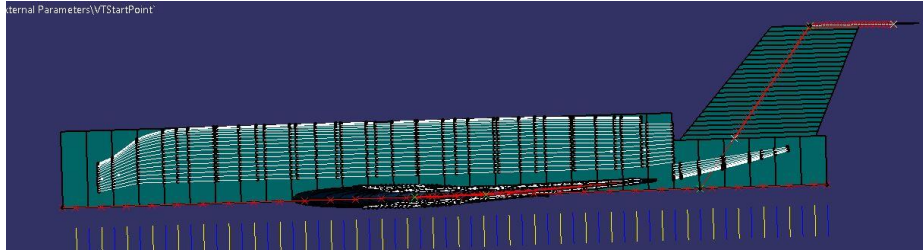
- Had trouble making it work with different design table configurations and different parts of aircraft

Mass Properties - Creation



- Switched from panel UDFs to panels created from code to make panelizing weights easier
- Divides structural weight contributions from fuselage surfaces and stringers into panels

Mass Properties - Optimizing Code



- Code initially took 1-2 hours to run, so attempts were made to decrease required iterations
- Stringers were split into multiple lists so that code would not have to iterate through 1000 stringers each run through loop
 - Stringers were organized based on fraction of list, but this was unsuccessful
 - Stringers were organized based on fraction of fuselage length, this is in progress, but will likely be successful

Final Project Idea

- ATLASS for cars
 - Combine personal interest with knowledge acquired from this semester



Choices For Next Rotation

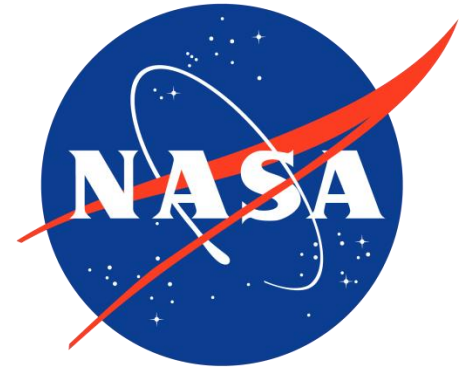
1. Service Engineering
2. Systems Test Design Engineering - Mechanical
3. Flight Test Engineering
4. Propulsion and Thermodynamics



Plans at Purdue

I have a few major goals for my time at Purdue:

1. Get a co-op at a reputable company - Check
2. Do research - NASA Extraterrestrial Habitat
3. Study abroad - France, Fall 2020
4. Work at the Innovation and Design Center - Summer 2019



Thank You!

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Questions?

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