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Integrated Aircraft Design Network

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Fluid and Mechatronic Systems

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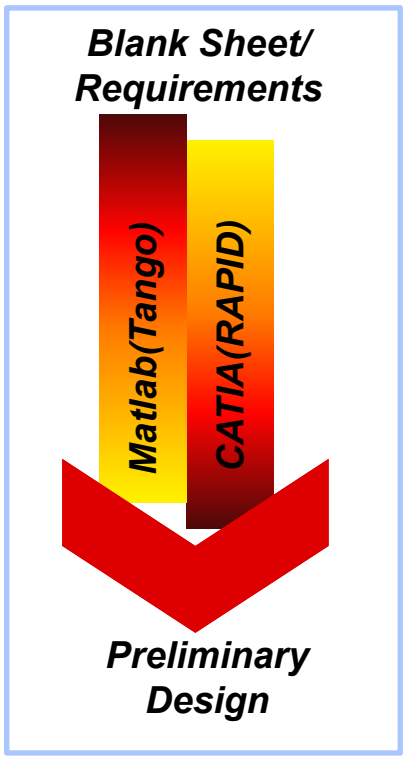
CONCEPT REALISATION LABORATORY

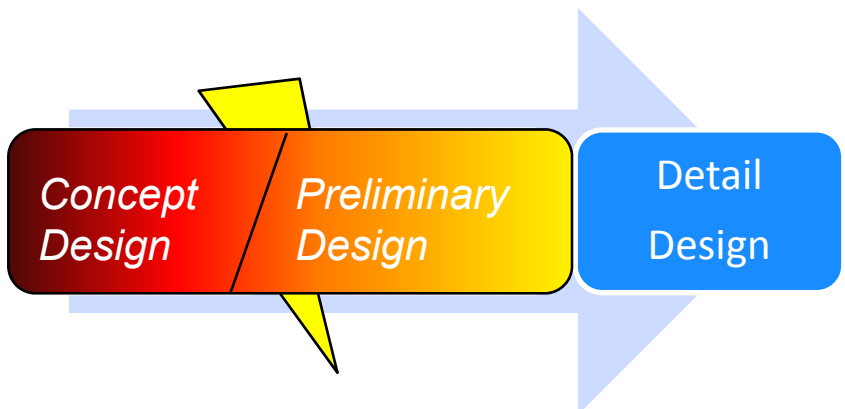
Agenda

- Aim
- Multidisciplinary Framework
- Aircraft Geometry Data Description
- Data Management
- XML Integration
  - RAPID XML
  - Tango XML
- Framework approach
- Implementation/Applications
- Conclusion
- Future Work

Aim



- *XML based multidisciplinary tool integration in a conceptual aircraft design framework*.
- ~~"One-tool"~~ or a "One-database" approach
- *Design Automation for fast realization of the concept*
- *To support **Conceptual** to **Preliminary** Aircraft Design*



Introduction

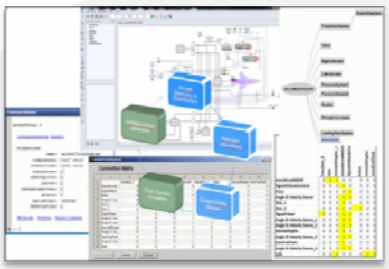
-Multidisciplinary Aircraft Conceptual Design Framework

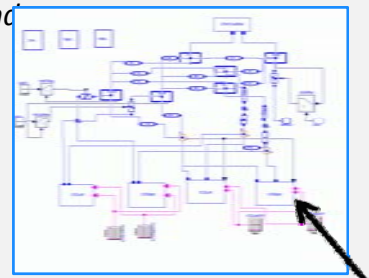
- **Tango** - Data handling and tool integration, a/c sizing, mission calculation,aerodyn. calculations (e.g. Tornado), a/c systems definiton
- **RAPID** - Sizing, Geometry definition, Structure definition, Geometry for Aerodynamic and Structural analysis
- **Hopsan** - Performance, Stability and Control, Fault Analysis
- **Dymola** - Systems architecture, power analysis, Verification

Hopsan

Total System Simulation (mission)

- ***On-board power Systems / Subsystem simulation:***
  Hydraulic (Flight Control System)
  Fuel System, Electric System, etc.
- ***Outcomes:***
  Performance, Stability and Control ,Fault Analysis





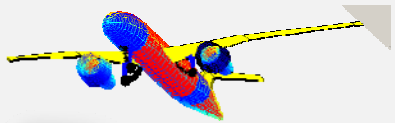
Dymola / Modelica

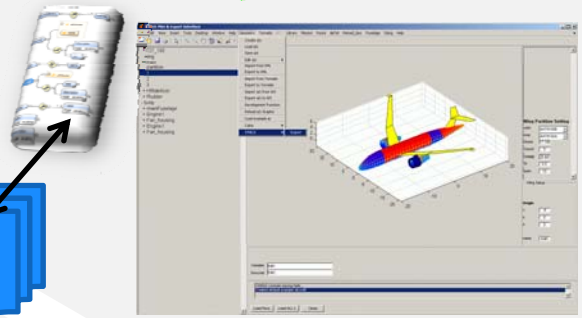
usage of ModelicaXML

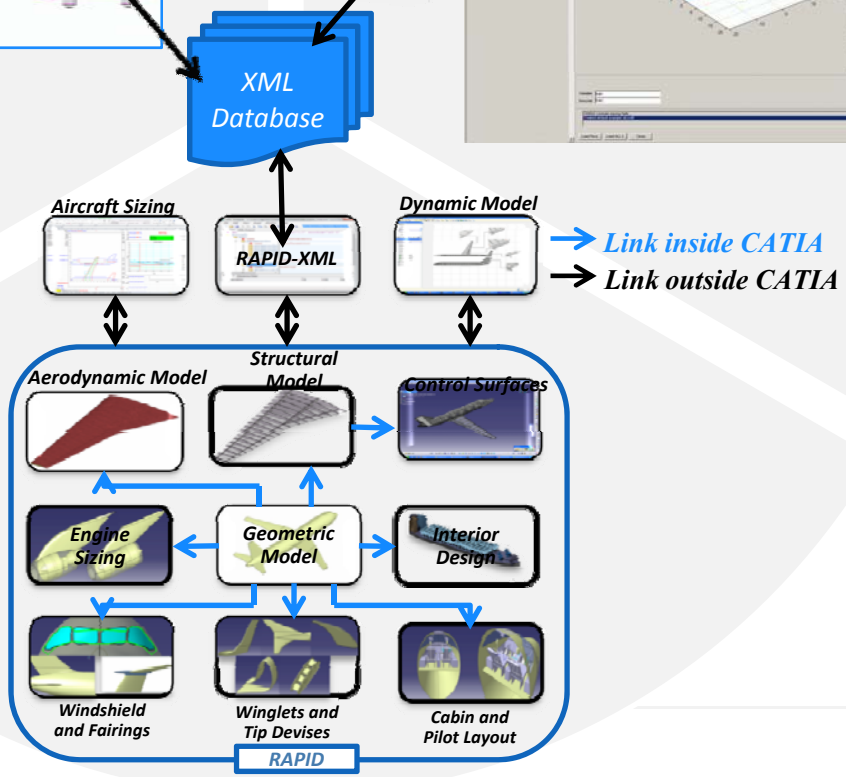
- ***System Simulation:***
  ECS (Cooling , pressurization and Ventilation Systems)
  Thermal Management System
- ***Outcomes:***
  Systems architecture / control modes, power analysis
  Verification

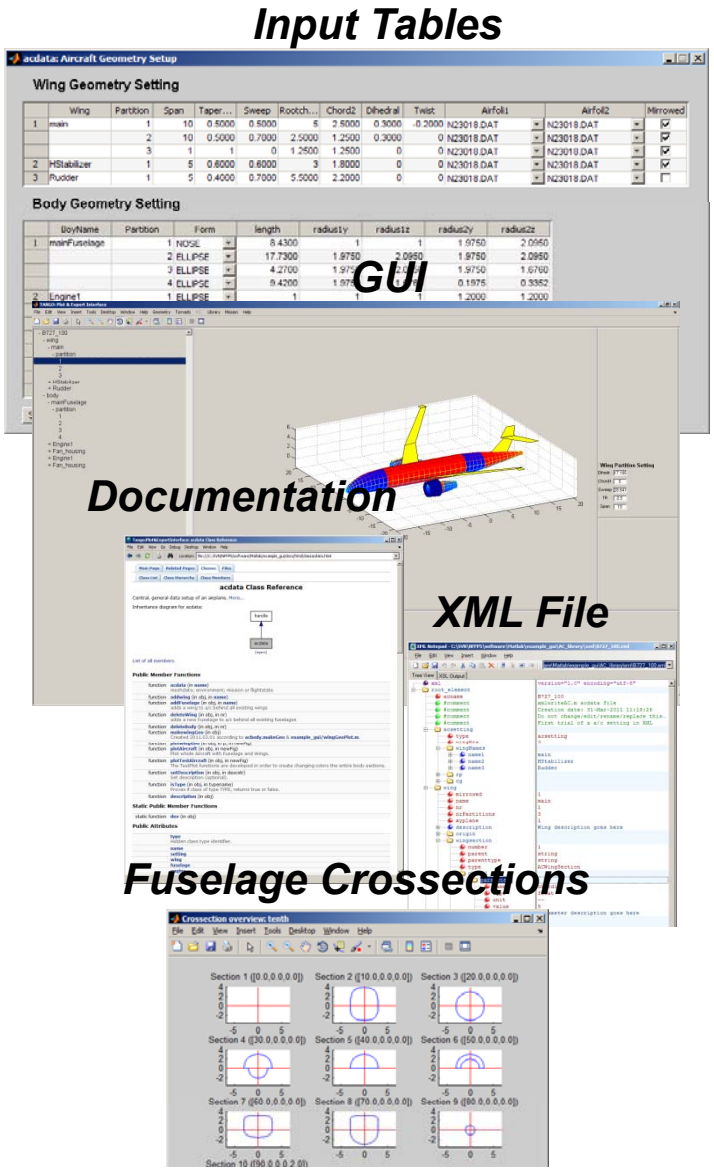
Tango (Matlab)

- *aircraft designer & configurator*
- *aircraft sizing & design benchmark*
- *system integration*
- *knowledge based system design generation (simulation model export)*









Tango

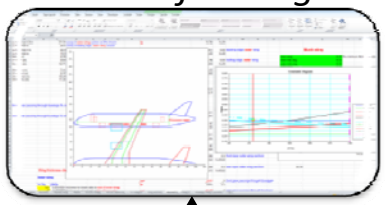
- A conceptual a/c design tool

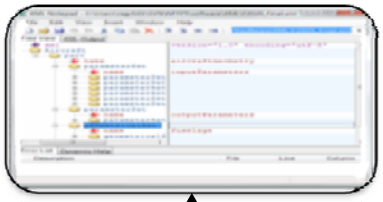
Parametric a/c configurator including

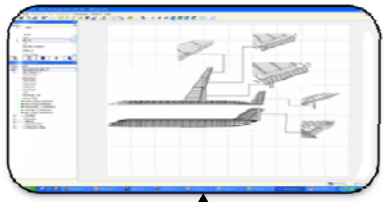
- frameworks main GUI, data handling and tool integration
- Main topics:
  - a/c sizing
- a/c layout builder, including:
  - engine models
  - landing gear, control surfaces, control modes, etc…
- mission calculation
- aerodyn. calculations (e.g. Tornado)
- a/c systems definiton

Implementation:

- object orientated class-based Matlab (prepared for C++ mitigation)
- separated GUI overlay


Aircraft Sizing

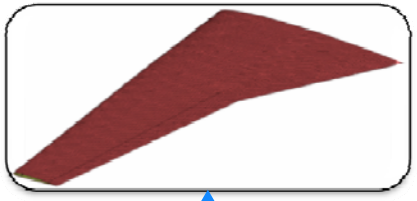

XML Database


Dynamic Model

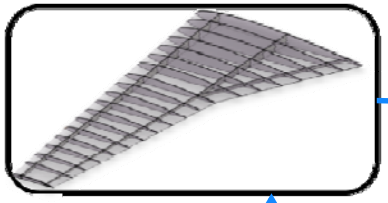
→ *Link inside CATIA*

→ ***Link outside CATIA***

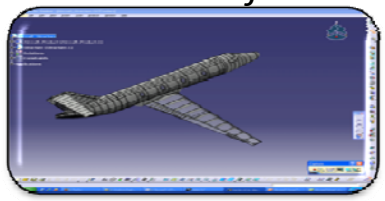
Aerodynamic Model

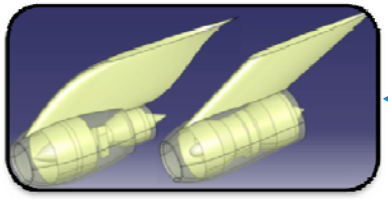


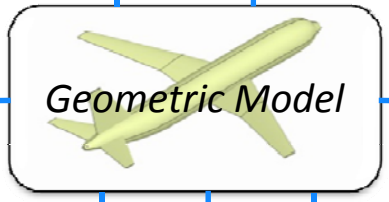
Structural Model

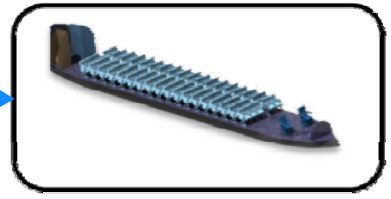


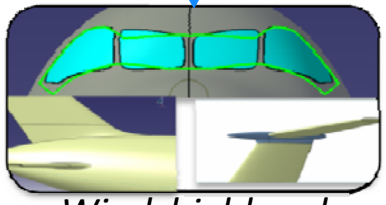
Control Surfaces

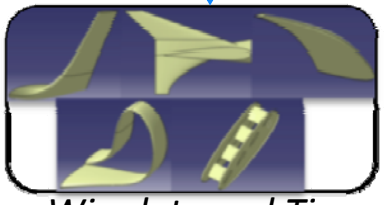


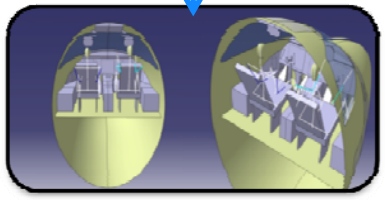

Engine Sizing


Geometric Model


Interior Design


Windshield and Fairings

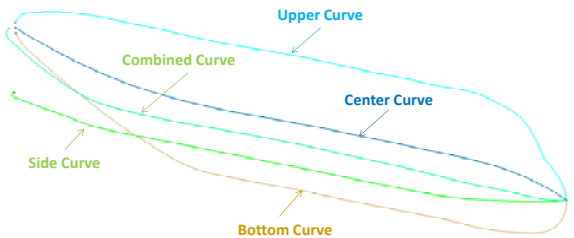

Winglets and Tip Devises

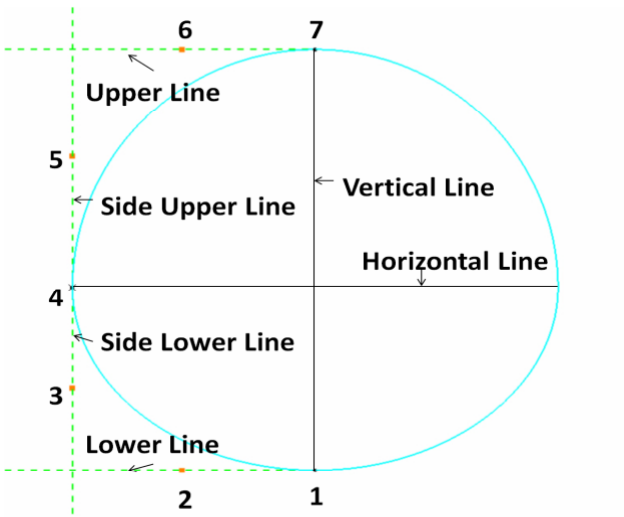

Cabin and Pilot Layout

RAPID

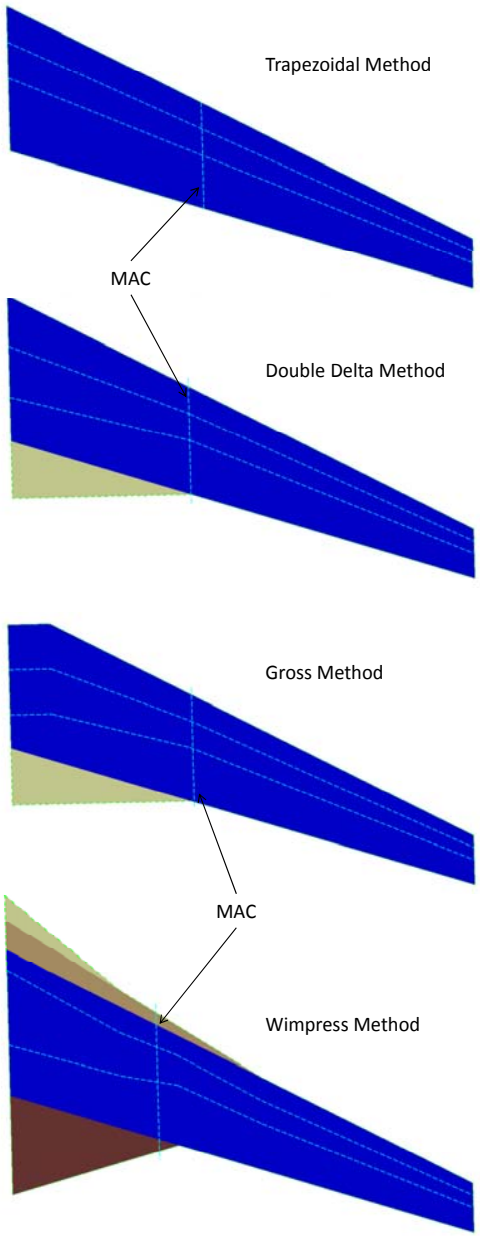
Aircraft Geometry Data Description

-Fuselage geometry description





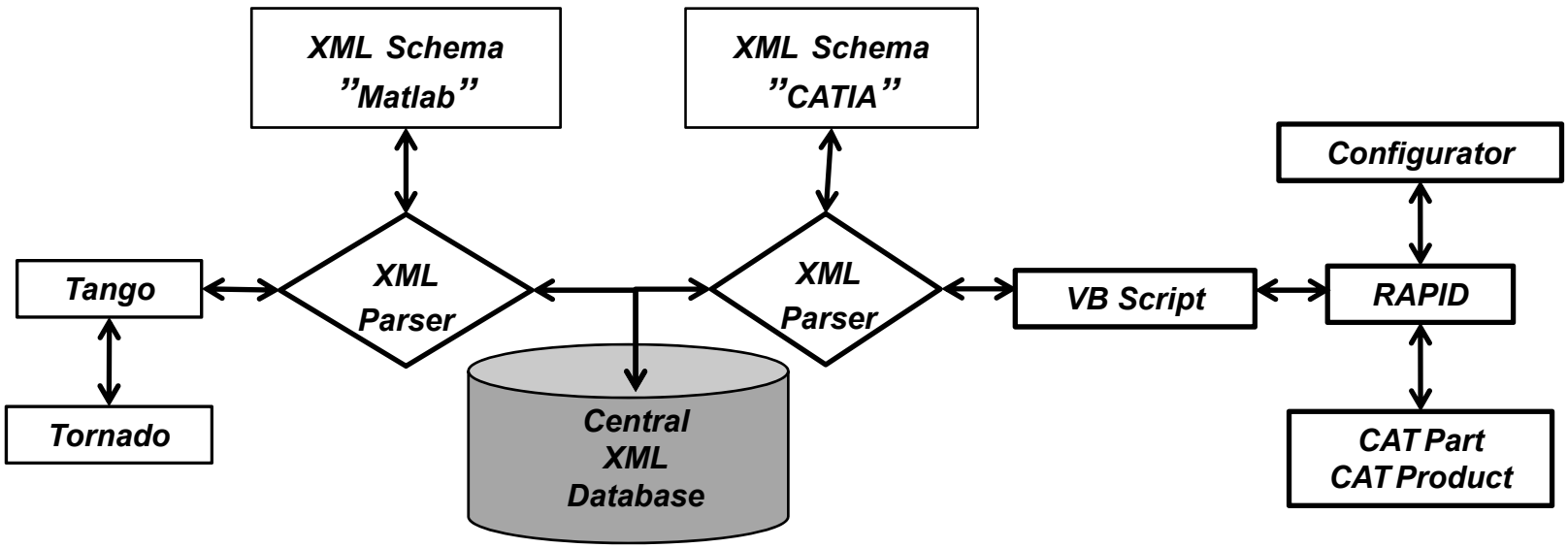
- Four Splines to create the foundation for the Fuselage
- Two 3rd order Bezier curves

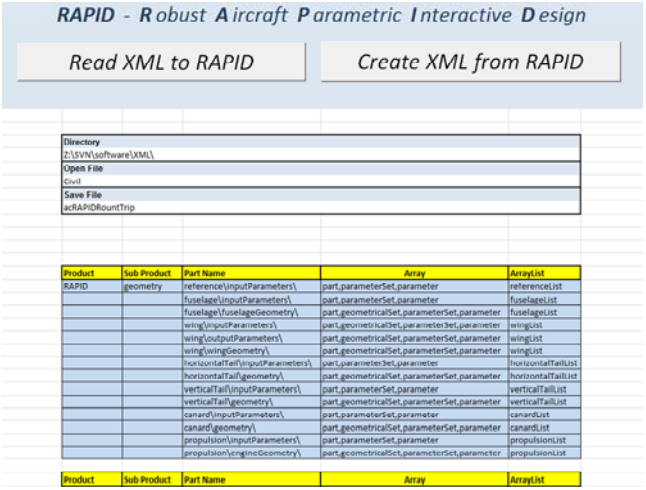


Aircraft Geometry Data Description
- Wing Description

- Trapezoidal Method
- Double delta Method
- Gross Method
- Wimpress Method

Data Management





XML Integration

- *RAPID XML Export*

- Configuration of Parameter and Geometric sets through Excel

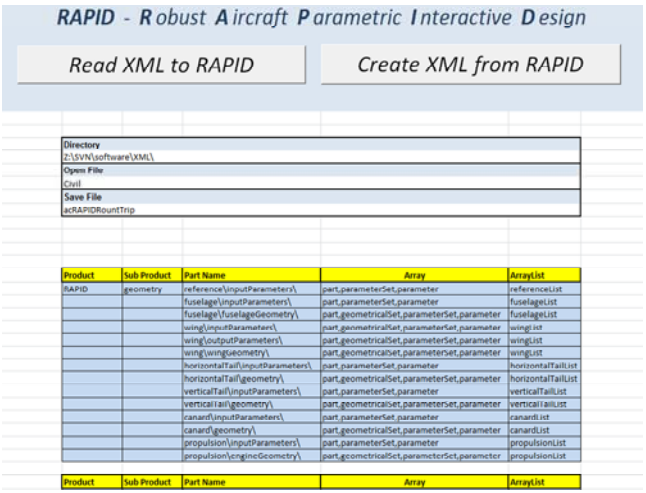
  Example: “fuselage\inputParameters\” & “fuselage\instantiatedGeometry\”

- Value Parsing
- Writing into XML using DOM Object
- Spline from CATIA to XML

  Example: “fuselage\exchangeTest”

- Finally the XML DOM object is written to XML

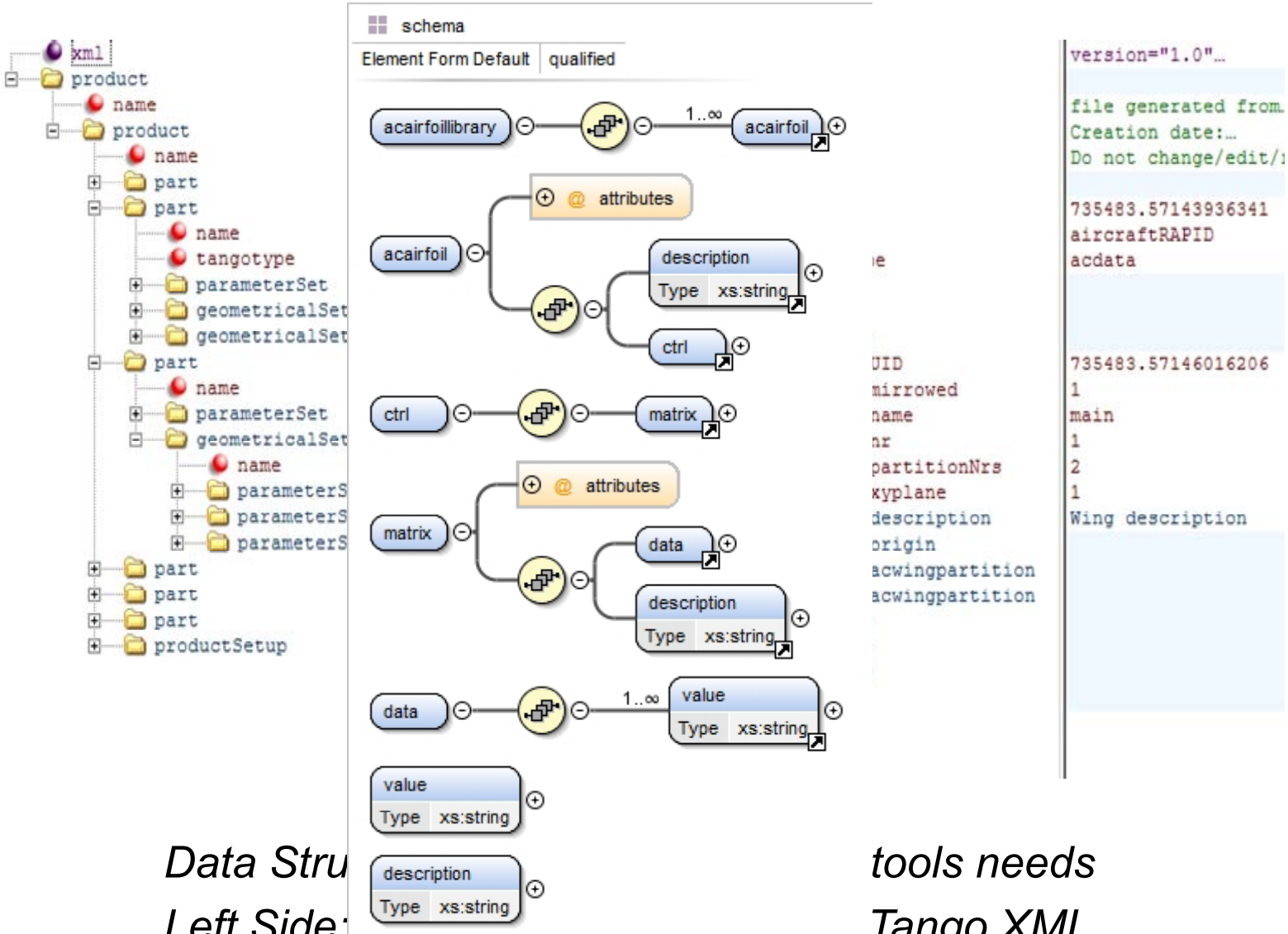
XML Integration
- *RAPID XML Import*



- Parsing the XML using DOM object
- Recursive Function to get child nodes
- Constructing the Parameter Strings to be updated
- Spline from XML to CATIA
- Updating CATIA

XML Integration
- *Tango XML*

- Tango makes usage of the underlying Java DOM application classes in Matlab that serves for the XML data handling.
- Class-related XML parsing functionalities allows for greater flexibility and fast replacement or appending of new classes.
- The basic classes are product–geometry related arranged (e.g., wing and underlying wing partition class)
- Higher level classes are product-functional (system) related (e.g., fuel system, primary flight control system).

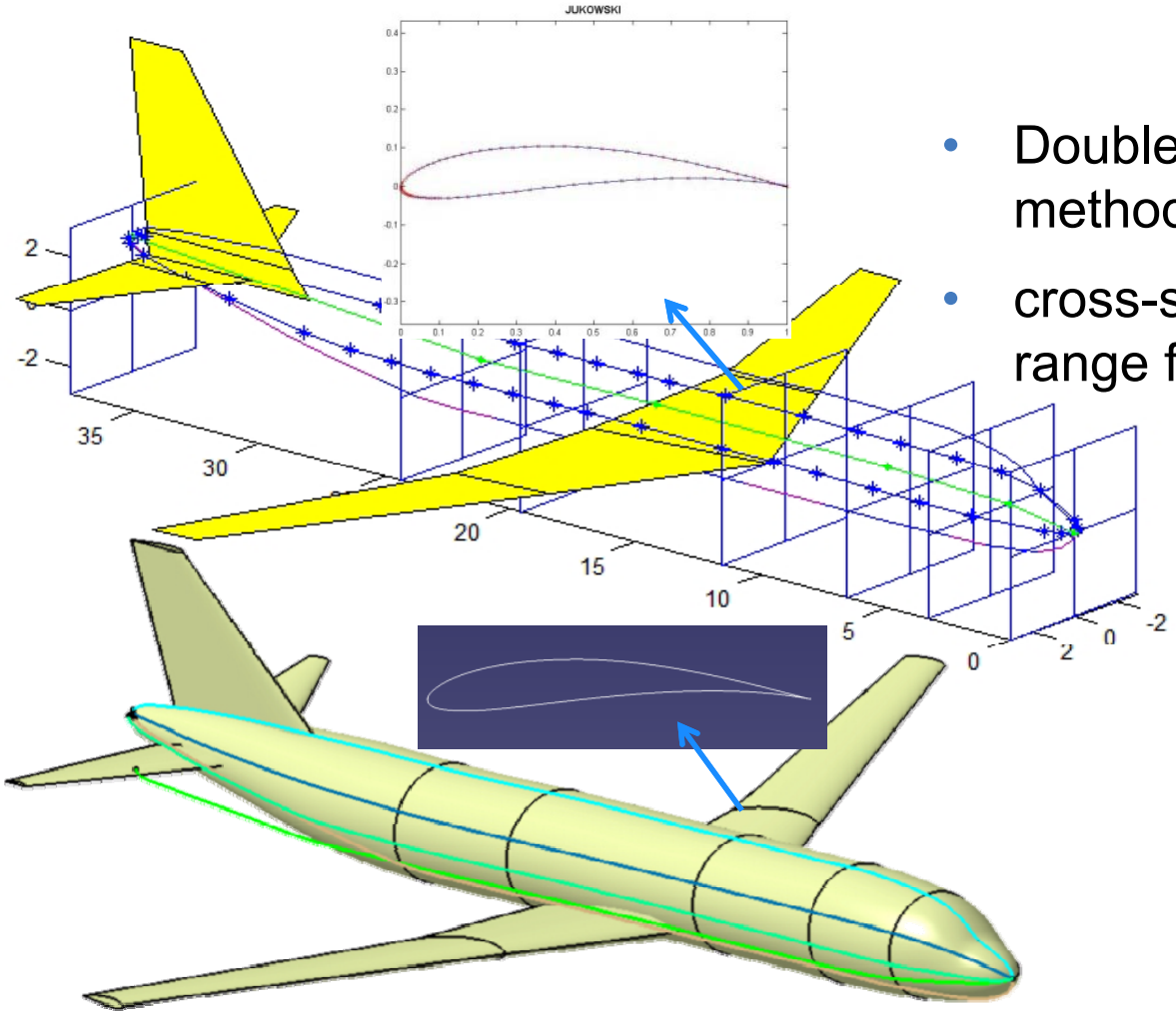


Data Stru *tools needs*

Left Side: *Tango XML*

XML Schema

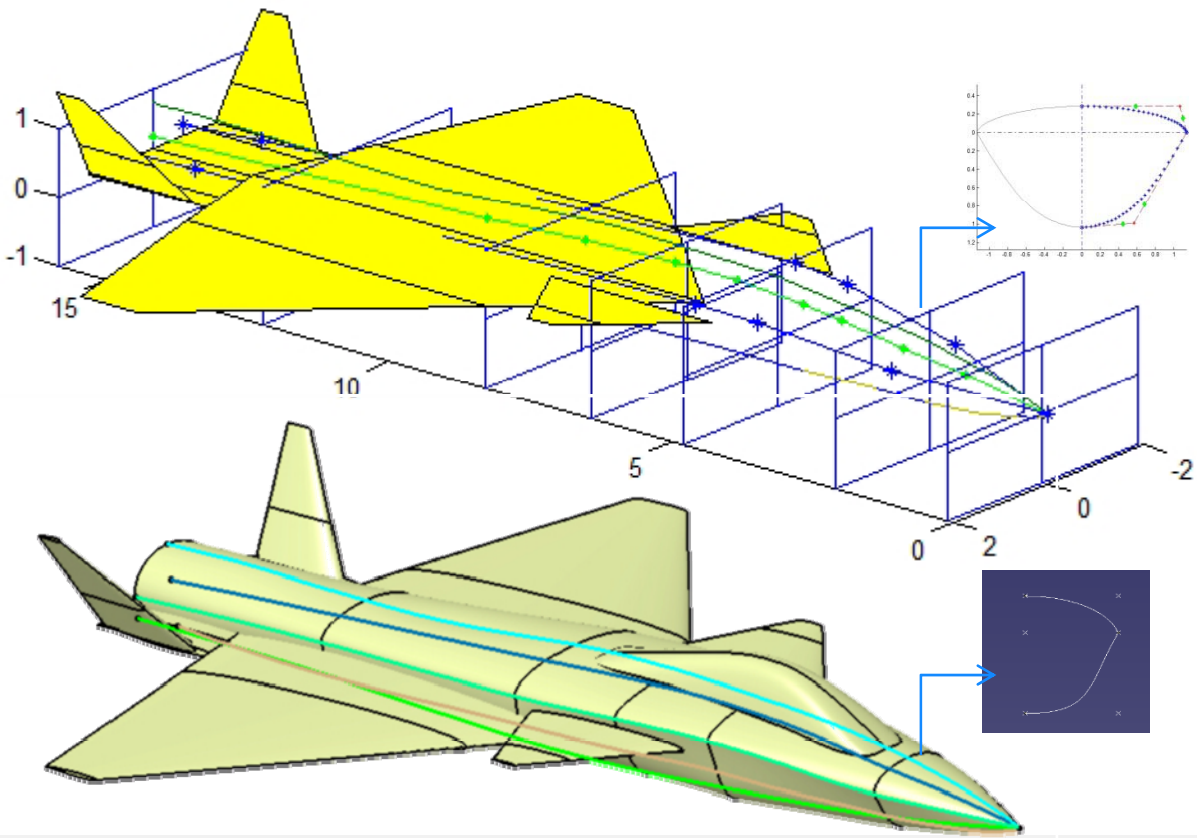
Application Example 1



- Double delta reference method
- cross-sections of the fuselage range from a circle to ellipse

Application Example 2

- Same data Structure as E.g.1
- Canard is added



Conclusions

- Multidisciplinary conceptual aircraft design analysis based on a central parametric XML database.
- This database -containing all project related data- is intended to grow simultaneously with the refined specification of the airplane
- The unified geometry makes meshing easier and serves for no aperture for high fidelity CFD

THANK YOU

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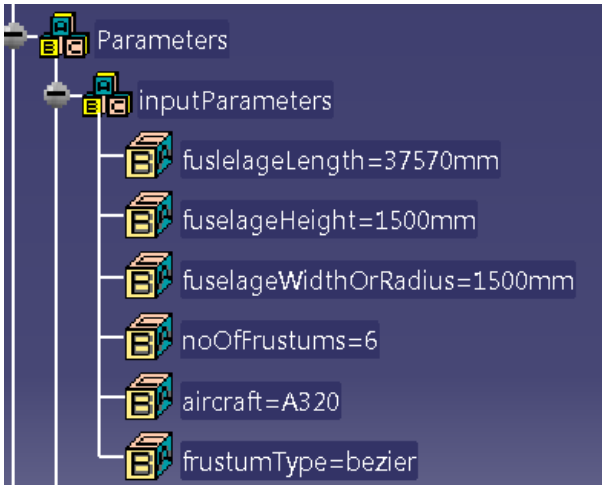
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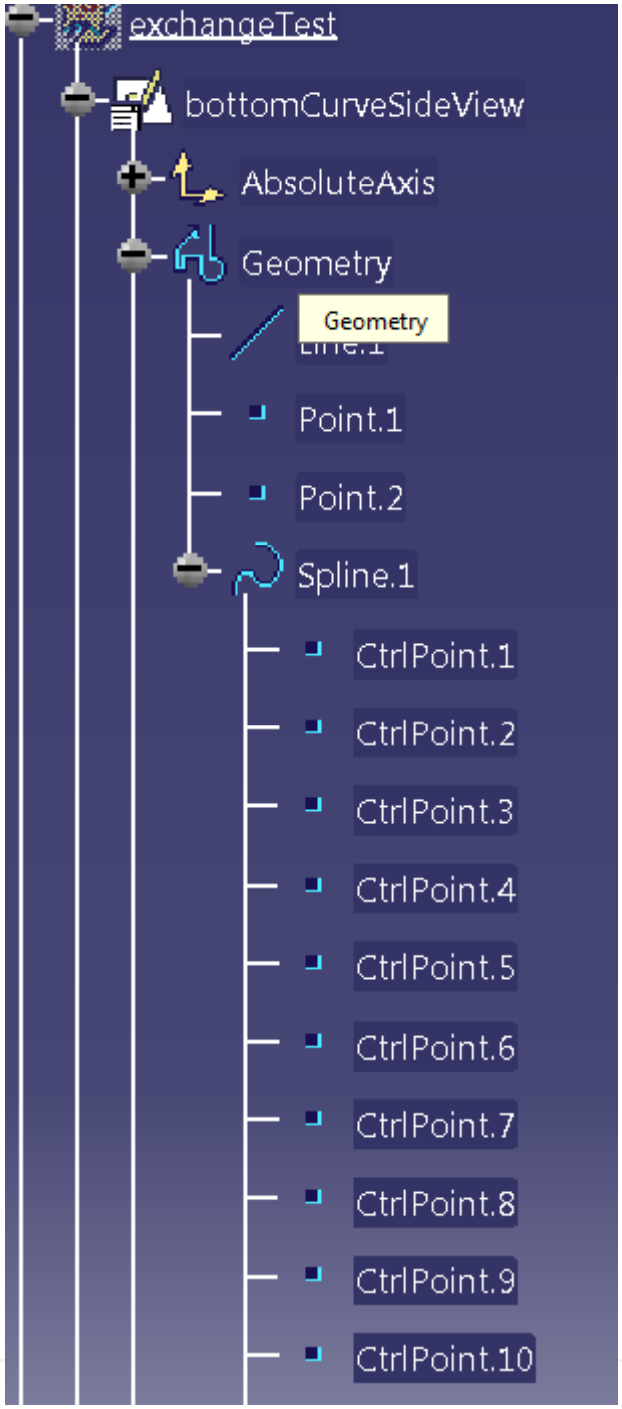
fuselageHeight=1500mm
fuselageWidthOrRadius=1500mm
noOffrustums=6
aircraft=A320
frustumType=bezier


exchangeTest
bottomCurveSideView
AbsoluteAxis
Geometry
Geometry
Point.1
Point.2
Spline.1
CtrlPoint.1
CtrlPoint.2
CtrlPoint.3
CtrlPoint.4
CtrlPoint.5
CtrlPoint.6
CtrlPoint.7
CtrlPoint.8
CtrlPoint.9
CtrlPoint.10