Integrated Aircraft Design Network

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FluMeS
Fluid and Mechatronic Systems
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 definition

- **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

Tango (Matlab)
• aircraft designer & configurator
• aircraft sizing & design benchmark
• system integration
• knowledge based system design generation (simulation model export)

Dymola / Modelica
usage of ModelicaXML
• System Simulation:
  ECS (Cooling, pressurization and Ventilation Systems)
  Thermal Management System
• Outcomes:
  Systems architecture / control modes, power analysis
  Verification

XML Database

Aircraft Sizing
RAPID-XML
Dynamic Model

Link inside CATIA

Link outside CATIA

Geometric Model
Engine Sizing
Aerodynamic Model
Structural Model
Control Surfaces
Windshield and Fairings
Geometric Model
Winglets and Tip Devices
Interior Design
Cabin and Pilot Layout
API-RAPID
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 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 Structure adapted towards the tools needs

**Left Side:**
- RAPID XML
- 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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