Integrated Aircraft Design Network

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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
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

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XML Schema "Matlab"
XML Schema "CATIA"

XML Parser
XML Parser

Central XML Database

Tango
Tornado

VB Script

RAPID

Configurator

CAT Part CAT Product
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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 ; Right 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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