Collaborative Design at DLR in Distributed and Co-Located Environments

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Presentation Outline

• Introduction
• Technical collaboration
• Human collaboration
• Conclusion
Aircraft Design
Potential Solutions For Future Air Transport

Mobility
Environment
Economy

Propulsion
Aerodynamics
Structures

DEMAND

TECHNOLOGIES

DLR / Airbus

Martin Jetpack

dlr / airbus
Collaborative Aircraft Design
Merging Competences

- Optimization
- Meta-Modeling
- Sensitivities
- Parameterization
- Requirements, Targets
- Central Data Model CPACS
- Performance, Properties
- Iteration

Analysis 1
Analysis 2
Analysis n
Multidisciplinary Design & Optimisation
Definition introduced by Prof. I. Kroo and Prof. J.J. Alonso, Stanford University

1st generation
- analysis-based design computations
  - optimisation algorithms
  - approximation techniques

2nd generation
- Workflow management
  - networked computing
  - # disciplinary interfaces ↑

3rd generation
- Optimisation assisted design in teams
  - management of knowledge
  - collaboration of engineers and tools
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CPACS Data Model
Common Parametric Aircraft Configuration Scheme

- Extensible Markup Language XML: Open W3C standard.
- Text format using <tags> to build hierarchic structure.
- CPACS is a XML schema definition containing conventions of possible elements and their arrangement.
- Actual CPACS files are build for the specific use case following the CPACS schema.
CPACS Experiences
Wide & Extensible Design Space

- Wing & Tube
- BWB
- SSBJ

P. D. Ciampa, et. al., CST parametrization for unconventional aircraft design optimization, *International Council of the Aerospace Sciences (ICAS) 2010, Nice, France*
CPACS Experiences
Multidisciplinary Modelling

CPACS
Structure
Aero
Loads
CPACS Experiences
Multi-Fidelity Modelling

- LiftingLine
- 3d Panel
- EULER

CPACS Experiences
Multi-Scale Modelling

Component

Aircraft

Fleet

A. Koch, et.al., Climate impact assessment of varying cruise flight altitudes applying the CATS simulation approach, 3rd International Conference of the European Aerospace Societies (CEAS), Venice, Italy (2011).
Building Disciplinary Models Based On CPACS
Different Ways Of Accessing CPACS

F. Dorbath, et.Al., A knowledge based approach for extended physics-based wing mass estimation in early design stages, CAS 2012-1.1.1
Building Disciplinary Models Based On CPACS

Different Ways Of Accessing CPACS
• Compatibility releases for ModelCenter from version 7.1 to 8,9 and 10
• Compatibility releases for Analysis Server from version 5.12 to 6 and 7
  • Windows 7 compatibility
  • 2011 last full version of toolsuite
  • 2012 last bug fix
• GUI components for remote server inspection, log introspection and more
• Centralized config file with server information replaced by proxy approach
• Replaced string variables by raw file variables
  • Zipped and not saved with workflow
• All result plots and satellite data transferred in compressed variable
Example: Distributed workflow built with CPACS + ModelCenter: aerodynamic-structural coupling

• Mode of operation: Use ModelCenter mainly as
  • workflow driver and communication/transport layer
  • for optimization (convergers)
  • assuming a blackbox approach behind generalized code wrappers
  • for post-processing (response surface, surrogate models)

• Goal: Extending an existing multidisciplinary workflow for aircraft design
  • Use better physics-based methods for estimation of aerodynamics
  • Still in predesign phase, runtime only several hours
  • Results differ significantly from previous results that neglect the interdisciplinary coupling and snowball effects
Our wishes for ModelCenter:

- No more new features required
- Single most important feature wanted: Stability
  - Random crashes, not always reproducible
  - Runtimes over days
  - Resilience over server outages – don’t stop the world
- Saveable workflow files cannot be reloaded (memory issues)
  - Could be solved by storing big variable contents in satellite files
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New Challenges
„Having Tools“ does not mean „Having Skills“
Challenges in Collaboration

3rd Generation MDO

- Debugging
- Comprehension
- Heterogeneous team of specialists
- Collaboration
- Management
- Communication
- Handling knowledge

→ 3rd Generation MDO

- Finding partners with 2nd Generation MDO expertise
- CPACS Symposium
The Integrated Design Laboratory (IDL)
The Integrated Design Laboratory (IDL)

• The IDL is a versatile platform for experiments in collaboration
• Encourage and enhance multidisciplinary collaboration
  • Strive to work within highly-integrated interdisciplinarity
• Provide the technical environment necessary for maximum flexibility,
  • regarding desk and seating arrangements
  • regarding network connectivity
  • regarding sharing users‘ displays
  • regarding face-to-face and team communication
• Serve as a laboratory to investigate and improve collaboration methods
  • regarding software integration
  • regarding knowledge management
  • regarding human factors
  • regarding collaboration methods
The integrated design lab - prototype
The integrated design lab - prototype
The integrated design lab – next generation
Feedback and input devices
The integrated design lab – cockpit simulator
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Conclusion

- Taking on the 3rd generation MDO with experiments in the IDL
- Join the CPACS community!
  - 3rd CPACS symposium at CEAS in Linköping
    17-19 September 2013
- Find all open source software at DLR on http://software.dlr.de
- Come and visit our Integrated Design Laboratory
  - We’d like to share our experiences – become a partner
  - We’d like to offer our room and equipment for collaboration effort
Thank you very much!