Aero – Aircraft Design and Systems Group

Current Status

Prof. Dr.-Ing. Dieter Scholz, MSME

08-12-04
Aero – Aircraft Design and Systems Group

• Aero is **part of:**
  Research Focal Point Aeronautical Engineering
  Department of Automotive and Aeronautical Engineering
  Faculty of Engineering and Computer Science

• Aero's **aim** is to guide research assistants to cooperative dissertations and to conduct funded projects in research, development and teaching (short courses).
Aero – Aircraft Design and Systems Group

**Emphasis** of our work is on:
- Aircraft Design
- Aircraft Systems
- Flight Mechanics

**Current projects** with partner organisations:
- Green Freighter
- ALOHA, Efficient Airport (Aviation Cluster Hamburg)
- PAHMIR
- CARISMA

**Past projects** with partner organisations:
- FLECS
Cooperative Dissertations

Dipl.-Ing. Kolja Seeckt
(Green Freighter)
Dipl.-Ing. Francisco Gómez Carrasco
(ALOHA)

Dipl.-Ing. Mihaela Niţă
(CARISMA)
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Presently two short courses are being offered.

- **Aircraft Design**
  
  Next course: May 2009 (one week)

- **Introduction to Aeronautical Engineering**

  Next course: January 2009 (one week)
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Research assistants at Aero:
Dipl.-Ing. Kolja Seeckt (Green Freighter)
Dipl.-Ing. Francisco Gómez Carrasco (ALOHA)
Dipl.-Ing. Mike Gerdes (PAHMIR)
Dipl.-Ing. Mihaela Niță (CARISMA)
Dipl.-Ing. Philip Krammer (Fuel Cell Integration)
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Information available on the WWW:
http://Aero.ProfScholz.de
• Reports@Aero

http://bibliothek.ProfScholz.de
• Digital Library: Student Projects, Thesis Work
FLECS
Functional Model Library of the Environmental Control Systems

- Total: 648 k€
- HAW: 162 k€
- 2 years
- Partners: Airbus, CeBeNetwork
- Sponsors: Cities of Hamburg & Bremen
Functional Simulation of the Environmental Control System and the Cabin => FLECS Database

Support all Phases in the Design Processes
- Pre Design
- Simple Dynamics
- Detailed Dynamics

Investigation of a large Number of System Architectures => Optimum Architecture

Graphical User Interface
- Parameter Input Masks
- Main GUI
  → Cockpit GUI, Display GUI
  → Interactive Mode, Batch Mode
Component Classes

- Ambient Conditions
- Aircraft Boundaries
- Flow Resistances
- Flow and Pressure Sources
- Volumes
- Area models
- Mixing Unit
- Heat Exchangers
- Air Cycle Machine and Air Compressor
- Ram Flow
- Vapor Cycle Systems
- Sensors
- Controls
Example: Airconditioning Pack

- Air Cycle Machine
  (Compressor, Turbine)
- Heat Exchangers
- Water Separator
From the Block Diagram ...
... to the Simulation of Detailed Dynamics

MATLAB/Simulink
• C-Code Generation
• Real-Time Capability
→ Hardware in the Loop Testing
GF
Green Freighter

- Total: 646 k€
- HAW: 234 k€
- 3 years
- Partner: Airbus, TU Braunschweig, Bishop GmbH
- Sponsors: Federal Ministry of Education and Research
Aim of the project

• Investigations on **environmentally friendly** and cost effective freighter aircraft configurations

• “Environmentally friendly” due to:
  – Low fuel consumption
  – Low emissions ($\text{CO}_2$, $\text{NO}_x$)
  – Future fuels (Liquid hydrogen – LH$_2$, Synfuel, Biofuel)
  – Low noise level
Design analysis

- No crew (UAV-operation)
- Fuel tanks with liquid hydrogen
- Kerosene in wing tanks
- Unpressurized fuselage
- Cargo on two decks (no passengers)
Tools

- PreSTo: Aircraft Preliminary Sizing Tool
Tools

- **PrADO:**
  Preliminary Aircraft Design and Optimization

(Database system DMS, Geometry, Aerodynamics, Propulsion, Performance, Structure, Weight, CG, Flight characteristics, Operating costs (DOC))

Check with constraints.

Convergency check of related Design parameters okay?

Input:
- Mission
- Aircraft concept
- Regulations

Output:
- Optimized version
- Performance data
- Economic efficiency

Design analysis (Feasibility study)

Optimization

Parameter variation

Problem focused program libraries (Analysis and synthesis models of particular discipline)
ALOHA
Aircraft Design for Low Cost Ground Handling

- Total: 510 k€
- HAW: 140 k€
- 2 years and 4 month
- Partner:
  Airbus, Airport Research Center GmbH,
  Hamburg Airport
- Sponsor:
  Federal Ministry of Education and Research
Background

- Low Cost Airlines (LCA) fly today with mostly **Boeing B737 und Airbus A320**.
- Ryanair was the first European LCA founded in 1985.
- The B737 was developed in the 60th, the A320 in the 80th - also still at a time, where **LCA requirements were not included into the aircraft design**.
- Aircraft manufacturers started to work on **replacements for the models B737 and A320**.
- ALOHA helps to **include LCA requirements already from the start into the development of the successors of current single aisle aircraft**.
Turn Around Time and Cost Reduction

- New aircraft designs (lower sill height, ...)
- Faster boarding and deplaning (new door arrangement)
- Simpler baggage loading (moving belt, sliding carpet, ...)
- Autonomous boarding (integrated stairs, ...)
- Autonomous push-back
- Autonomous taxiing
- New handling operations
- Less airport charges
New Aircraft Designs (Previous Studies)

TU Delft

University of Stuttgart
Ground Handling Studies

- Ground handling analysis at airports
- Ground handing simulation (SIMBA)
- Analytical cost predictions
PAHMIR
Preventive Aircraft Health Monitoring for Integrated Reconfiguration

- Lead: Airbus
- HAW: 195 k€
- 3 years
- Partners:
  - Airbus, Philotech
- Sponsors:
  - Cities of Hamburg
Work Structure

Two topics in the area of aircraft cabins and cabin systems:

a) the reconfiguration of cabins,
   cabin modules and components
b) error detection and diagnostic systems
   for preventive maintenance
   of cabin systems.
CARISMA
Aircraft Cabin and Cabin System Refurbishing
Optimization of Technical Processes

- HAW: ??? k€
- 3 years
- Partner: ELAN GmbH
Training on Airbus A320 System Simulators
Short Course: Aircraft Design
Summary

• Aero: Aircraft Design and Systems Group
• FLECS
• Green Freighter
• ALOHA
• PAHMIR
• Efficient Airport (Aviation Cluster Hamburg)
• CARISMA
• Fuel Cell Integration (future project in the Aviation Cluster Hamburg)

• Training on Airbus A320 System Simulators
• Short Courses:
  – Aircraft Design
  – Introduction to Aeronautical Engineering