AAA and CPACS Coupling

Willem A.J. Anemaat
President DARcorporation
Background

• DARcorporation Formed in 1991 by:
  • Dr. Jan Roskam
  • Dr. Willem A.J. Anemaat

• Mission:

  Integrated Aircraft and Wind Turbine Design,
  Development and Engineering Consulting Services

  • Market, Support and Develop Airplane Design and Analysis Software
  • Market and Distribute Airplane Design Books written by Jan Roskam
  • Airplane Analysis and Design Consulting Services
  • Wind Turbine Aerodynamic and Structural Design/Analysis
  • Prototype Construction and Testing
  • 10 People (9 engineers, 1 Marketing/Sales Manager)
Prototyping and Manufacturing
Software

FAR 23 LOADS

• Provides a procedure to calculate the loads on an airplane according to the Code of Federal Regulations, Title 14 – Aeronautics and Space, Chapter I – Federal Aviation Administration, Subchapter C – Aircraft, Part 23 – Airworthiness Standards, Normal, Utility, Acrobatic and Commuter Category Airplanes, Subpart C – Structures.
• Loads on the airplane are determined by the three view drawing, the chosen maximum take-off weight and the chosen category and load factor.
Shark/AeroPack
Airplane Performance Program (APP)
Advanced Aircraft Analysis (AAA)
10 Independent modules for aircraft Design and Analysis:
• Weight
• Aerodynamics, Performance,
• Geometry
• Propulsion
• Stability & Control
• Dynamics
• Loads
• Structure
• Cost
Advanced Aircraft Analysis (AAA)

- Aircraft Conceptual/Preliminary design software
- Methods defined in
  - Dr. Jan Roskam’s 8 Part Design series
  - Airplane Flight Dynamics and Automatic Flight Controls, Parts I and II, by Dr. Jan Roskam
  - Airplane Aerodynamics and Performance, by Dr. C.T. Lan and Dr. Jan Roskam
  - Federal Aviation Regulations
  - DATCOM Methods
  - DAR Methods
- Fixed Wing: Tail Aft, Canard Only, Three Surface
- Military, Civil
MISSION SPECIFICATION

CLASS I

CLASS I DRAG

WEIGHT SIZING

PERF. CONSTRAINT ANALYSIS

EMPENNAGE SIZING

CONFIGURATION 3-VIEW

CLASS I WEIGHT

WEIGHT & BALANCE

GEAR DISPOSITION

STRUCTURE SIZING

IS CLASS I CONFIGURATION OK?

YES

CLASS II

AERODYNAMICS: S & C DERIVATIVES, HINGEMOMENTS, DRAG

INSTALLED THRUST/POWER

PERFORMANCE

LANDING GEAR DESIGN

RETRACTION KINEMATICS

3-VIEW WIRE FRAME/SURFACE

WEIGHTS

LOADS

STRUCTURE SIZING

V-n DIAGRAM

WEIGHT AND BALANCE

TRIM

DYNAMICS

TAB & HORN SIZING

FLYING QUALITIES

STICKFORCES

SIMULATION

COST

IS CLASS II CONFIGURATION OK?

NO

NO

Final Preliminary Design
Weight Sizing

Determine:
Take-off Weight, \( W_{TO} \)
Empty Weight, \( W_E \)
Fuel Weight, \( W_F \)

Wing Loading, \( W/S \)
Thrust Loading, \( T/W \)
Power Loading, \( W/P \)

Performance Constraint Analysis

Sensitivity

Given:
Type of aircraft
Number Passengers
Range
Speed
Reserves
Take-off Field Length
Landing Field Length

Mission Specification: Customer Requirements

Determine:
Wing Loading, \( W/S \)

Estimate/Update

\( C_{L_{max,claw}} \)
\( C_{L_{max,\lambda}} \)
\( C_{L_{max,T_O}} \)

Initial Sizing Done, Criteria:
Wing Area does not change
Flaps and Wing Lift OK

DARcorporation
Design • Analysis • Research
AAA Data Organization

• DAR Proprietary Currently (Does not Need to Be)
• Borland Paradox Based (Data Tables, uses BDE)
• ASCII (.ini, 64k limit) File for Data Tracking
• Combined in Zip-file: AAA Project File

• Issues:
  • BDE will be Discontinued
  • BDE Causes Installation and Run-time Problems
  • Slow
AAA Data Organization Continued

• Approximately 5,000 Parameters

• Organized in two Groups:
  • Flight Condition Dependent
  • Flight Condition Independent

• User Defined Flight Conditions:
  • Up to 97 Conditions Now
  • Next Release: limited to hard-disk space

• Export/Import:
  • ASCII
  • Excell
  • Export to AeroPack: ASCII (ini) .geo file
AAA Geometry Modeling

- **Lifting surfaces** defined by individual panels

- **Bodies (Fuselage, Nacelle, Stores, Tailbooms, Floats)** modeled by series of cross sections defined by four conic sections
Advanced Aircraft Analysis (AAA)
Geometry Data Exchange

AAA geo Format Export

Shark/AeroPack geo Format Import
Initial Data Exchange Work with KTH

Collaborative Aircraft Design using AAA and CEASION Linked by CPACS Namespace
A. Rizzi, P. Meng
Royal Institute of Technology, Sweden
B. Nagel, D. Boehnke
German Aerospace Center (DLR), Germany
W. A. J. Anemaat, J. Carroll
Design Analysis and Research Corporation, USA

Presented at CEAS 2013 The International Conference of the European Aerospace Societies
CPACS and AAA


• Intern from Germany, Ms. Stine Bubner (3 months in Spring 2014)

• Supervised by Erwin Moerland of DLR
CPACS and AAA

• 110 Pages of Mapping Information
• DAR Memo 996: Export AAA - CPACS (5)
• DAR Memo 997: Geometry Information Conversion from AAA to CPACS (58)
• DAR Memo 998: Weight Information Conversion from AAA to CPACS (17)
• DAR Memo 999: CPACS Aerodynamics Information (5)
• DAR Memo 1000: CPACS Loads Information (8)
• DAR Memo 1001: CPACS Systems Information (7)
• DAR Memo 1002: Propulsion Information Conversion from AAA to CPACS (10)
Status

• AAA Variable Mapping to CPACS Definition: Finished
• AAA CPACS Geometry Implementation will start in Spring 2015
• Release 2016 as AAA 4.0 (or 4.1)
• After Geometry Investigate Weight and Aerodynamics

• Parallel Development: Smart Aircraft Modeler (SAM), CPACS for Geometry (2 Year Development)
Thank You

Questions?