Integration of Multidisciplinary Engineering Analysis Software for Teaching & Research

Chivey Wu & Maj Mirmirani
Department of Mechanical Engineering
California State University, Los Angeles
Sept 14, 2000
Goals

• Interface for Multidisciplinary CAD/FEA/CFD/Control Software

• Courses in Multidisciplinary CAD/CAE

• Application to Flight Vehicle Design, Analysis and Control Simulation
<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CAD/FEM</td>
<td>SDRC IDEAS</td>
</tr>
<tr>
<td>• FEA/CFD</td>
<td>NASA STARS</td>
</tr>
<tr>
<td></td>
<td>CSULA I-Newton</td>
</tr>
<tr>
<td>• Flight Control</td>
<td>CSULA I-CONT</td>
</tr>
<tr>
<td>• Interface</td>
<td>CSULA I-STARS</td>
</tr>
<tr>
<td></td>
<td>GUI, DataTranslators</td>
</tr>
</tbody>
</table>
I-STAR Multidisciplinary CAE System

Vehicle Design

Engine Data

CAD Model

CFD Model

Structural FEA Model

Aerodynamic Coefficients

Pressure & Temperature

Mass Properties

Aeroelastic Analysis

Flight Dynamics & Control
... and the corresponding CFD mesh
CFD Simulation: Mach Contours
Aeroelastic analysis
Generic Hypersonic Vehicle - CAD Model
GHV - CFD Mesh
Aerodynamic Coefficients

![Graph showing Aerodynamic Coefficients CL, CD, CM vs Angle of Attack (deg)]
Effect of Elevator

![Graph showing the effect of elevator deflection on pitching moment coefficient with respect to angle of attack. The graph includes lines for different elevator deflections (-25 deg, -22.5 deg, -20 deg, -15 deg, -10 deg, 0 deg) and indicates a decrease in pitching moment coefficient as the angle of attack increases.]
Static Stress Analysis
Vibration Analysis
Nonlinear Control of a Hypersonic Vehicle

I-CONT Flight Control Simulator
Response to a Step Velocity Command
Courses

• ME318  Computer-Aided Mech Engr
• ME403  Aerodynamics
• ME409  Applied Multidisciplinary FEA
• ME454  Flight Dynamics Control
• ME508  Computational Fluid Dynamics
NASA-Sponsored Projects

• Integrated Aircraft Design & Analysis
  Dr. Chivey Wu

• Control of Hypersonic Vehicles
  Dr. Maj Mirmirani

• Applications of Inflatable Structures
  Dr. Lih-Min Hsia