

# Engineering Sketch Pad (ESP) Training

## Session 7: Putting it All Together

John F. Dannenhoffer, III

Syracuse University

Bob Haimes

Massachusetts Institute of Technology

Revised for v1.08





# Overview

- Multi-fidelity models
- Using UDCs to build aircraft components
- Assembling an aircraft
- Hand-on exercises
  - myGlider
  - myAircraft
- Course summary

- During the design of an aircraft, various coupled models are needed
  - different disciplines
    - structures
    - controls
    - aerodynamics
    - ...
  - different fidelities
    - conceptual design
    - preliminary design
    - detailed design
- There needs to be communication between these models



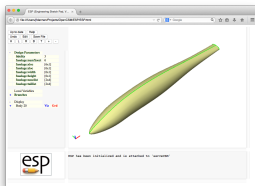
# Using UDCs to Build Aircraft Components

- Build a UDC for each major component type
  - wing
    - also used for tail surfaces
  - fuselage
  - duct
    - might use 2 ducts for high-bypass engine
  - pylon
    - connects ducts and wing



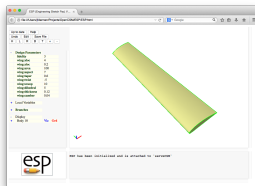
# Aircraft UDCs

fidelity = 3



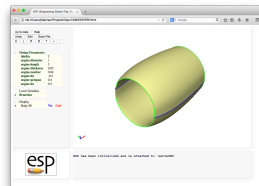
fuselage.udc

xloc (array)  
zloc (array)  
width (array)  
height (array)  
noselist ( $8 \times 1$ )  
taillist ( $8 \times 1$ )



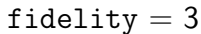
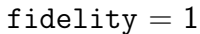
wing.udc

aspect  
taper  
twist  
sweep  
dihedral  
thickness  
camber



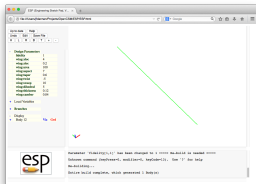
duct.udc

diameter  
length  
thickness  
camber

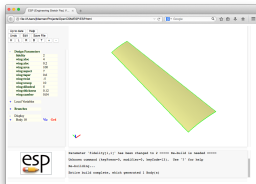




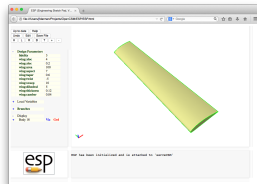
# Wing at 3 Fidelities



fidelity = 1



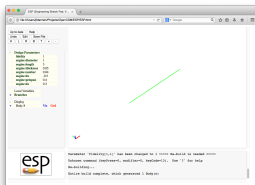
fidelity = 2



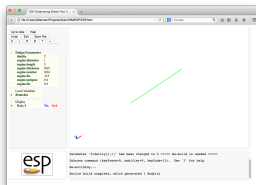
fidelity = 3



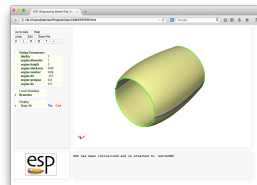
# Duct at 3 Fidelities



fidelity = 1



fidelity = 2



fidelity = 3



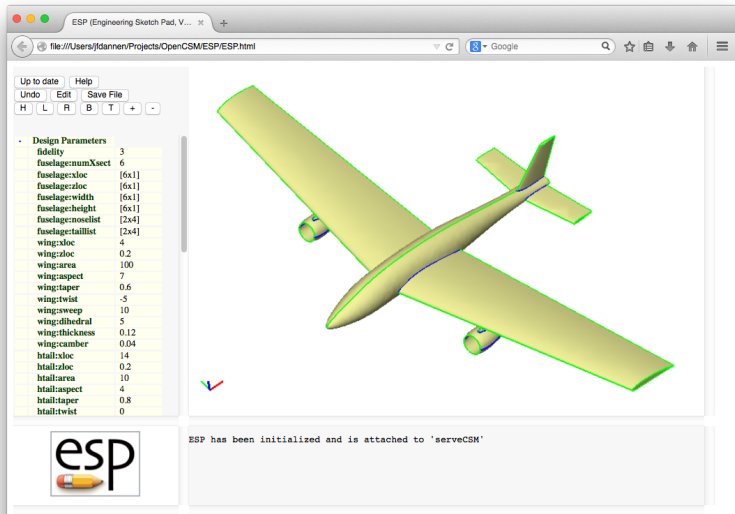
# Combine UDCs into Aircraft

- Majors steps:
  - Set up global parameters
  - Set up parameters for, and position of, each component
  - Call each UDC (perhaps multiple times)
  - If not first component
    - combine with previous components



# myPlane at fidelity=3

## Outer-mold line for CFD





# myPlane at fidelity=2

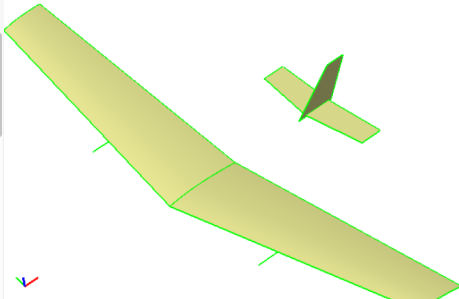
ESP (Engineering Sketch Pad, V...)

file:///Users/jfdannen/Projects/OpenCSM/ESP/ESP.html

Up to date Help  
Undo Edit Save File  
H L R B T + -

Design Parameters

fidelity	2
fuselage:numXsect	6
fuselage:xloc	[6x1]
fuselage:zloc	[6x1]
fuselage:width	[6x1]
fuselage:height	[6x1]
fuselage:noselist	[2x4]
fuselage:taillist	[2x4]
wing:xloc	4
wing:zloc	0.2
wing:area	100
wing:aspect	7
wing:taper	0.6
wing:twist	-5
wing:sweep	10
wing:dihedral	5
wing:thickness	0.12
wing:camber	0.04
htail:xloc	14
htail:zloc	0.2
htail:area	10
htail:aspect	4
htail:taper	0.8
htail:twist	0



Parameter 'fidelity[1,1]' has been changed to 2 ===== Re-build is needed <=====

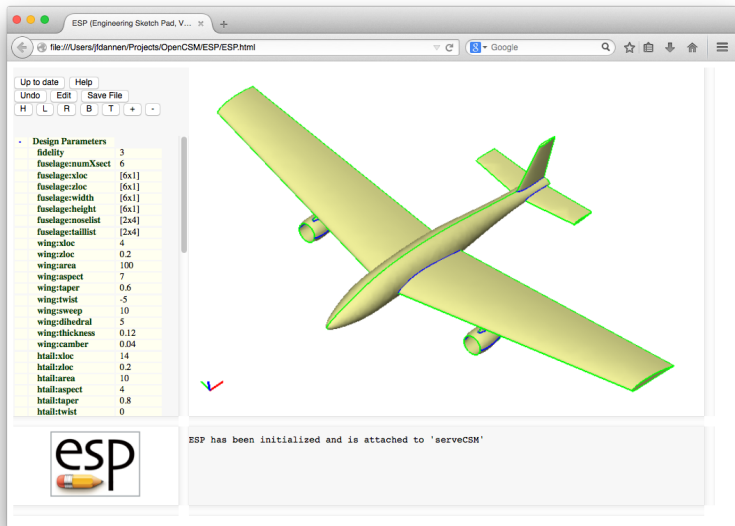
Unknown command (keyPress=0, modifier=0, keyCode=13). Use '?' for help

Re-building...

Entire build complete, which generated 7 Body(s)



# myPlane at fidelity=3





# Hands-on Exercises

- Run data/CAPS/myPlane
  - vary Design Parameters
  - vary fidelity
- Add a tip-mounted pod
  - use fuselage.udc



# Muddy Cards

- Questions / suggestions about multi-disciplinary models
- Questions / suggestions about multi-fidelity modes
- Overall effectiveness of course