Automated, Multifidelity Aero-Structural Modeling for Design of Military Aircraft

Dean E. Bryson
Aerospace Systems Directorate
Air Force Research Laboratory

Nitin D. Bhagat
Applied Mechanics Division
University of Dayton Research Institute

Robert Haimes
Aerospace Computational Design Laboratory
Massachusetts Institute of Technology

John F. Dannenhoffer, III
Aerospace Computational Methods Laboratory
Syracuse University

The Need: Rapid, accurate performance predictions for early design

- Avoid costly design flaws
- Leverage beneficial physics

Barriers:

- Level of definition required
- Time investment in CAD geometry
- Touch labor to generate analysis inputs
- Reverse engineering geometry for different analyses
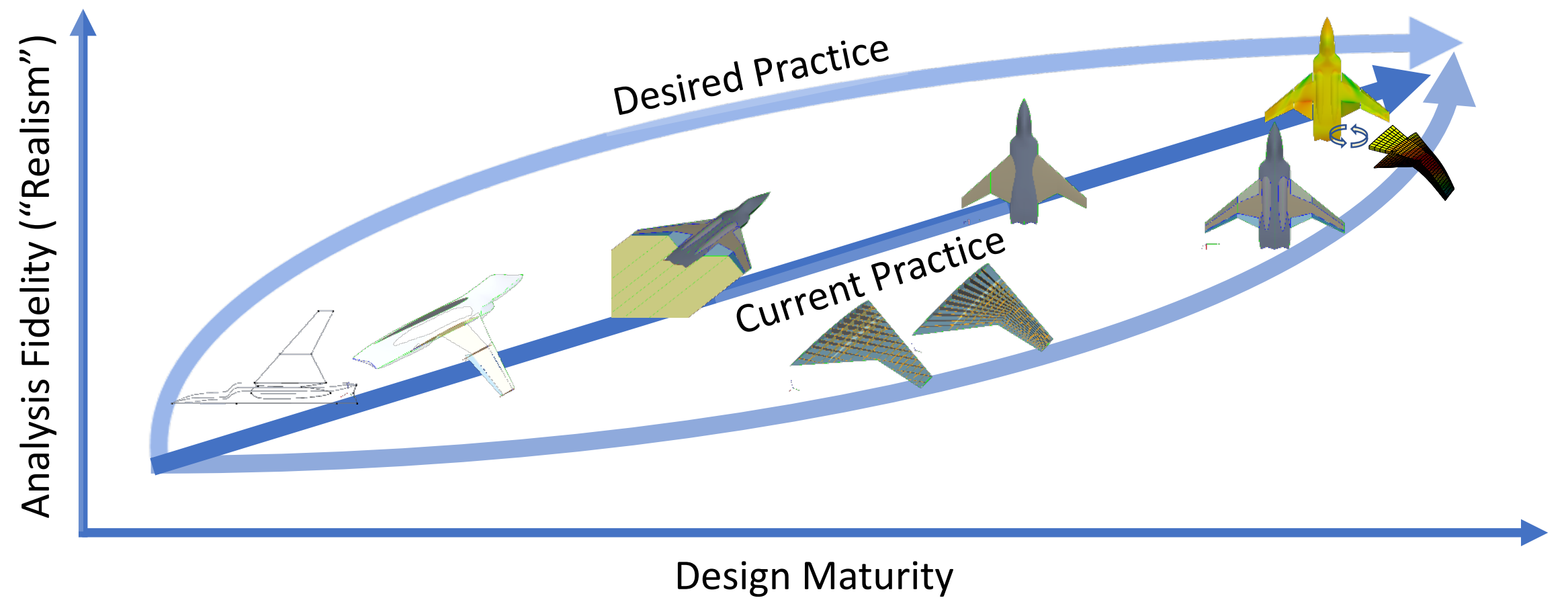
The Goal: A design environment enabling a flexible spectrum of analysis fidelities at any level of design maturity

The Idea: Active, persistent, use-specific geometry produced from a Design Model conveying Design Intent

- What features represent
- How features vary parametrically
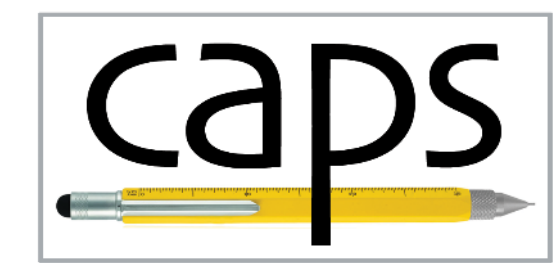- How analyses treat different features
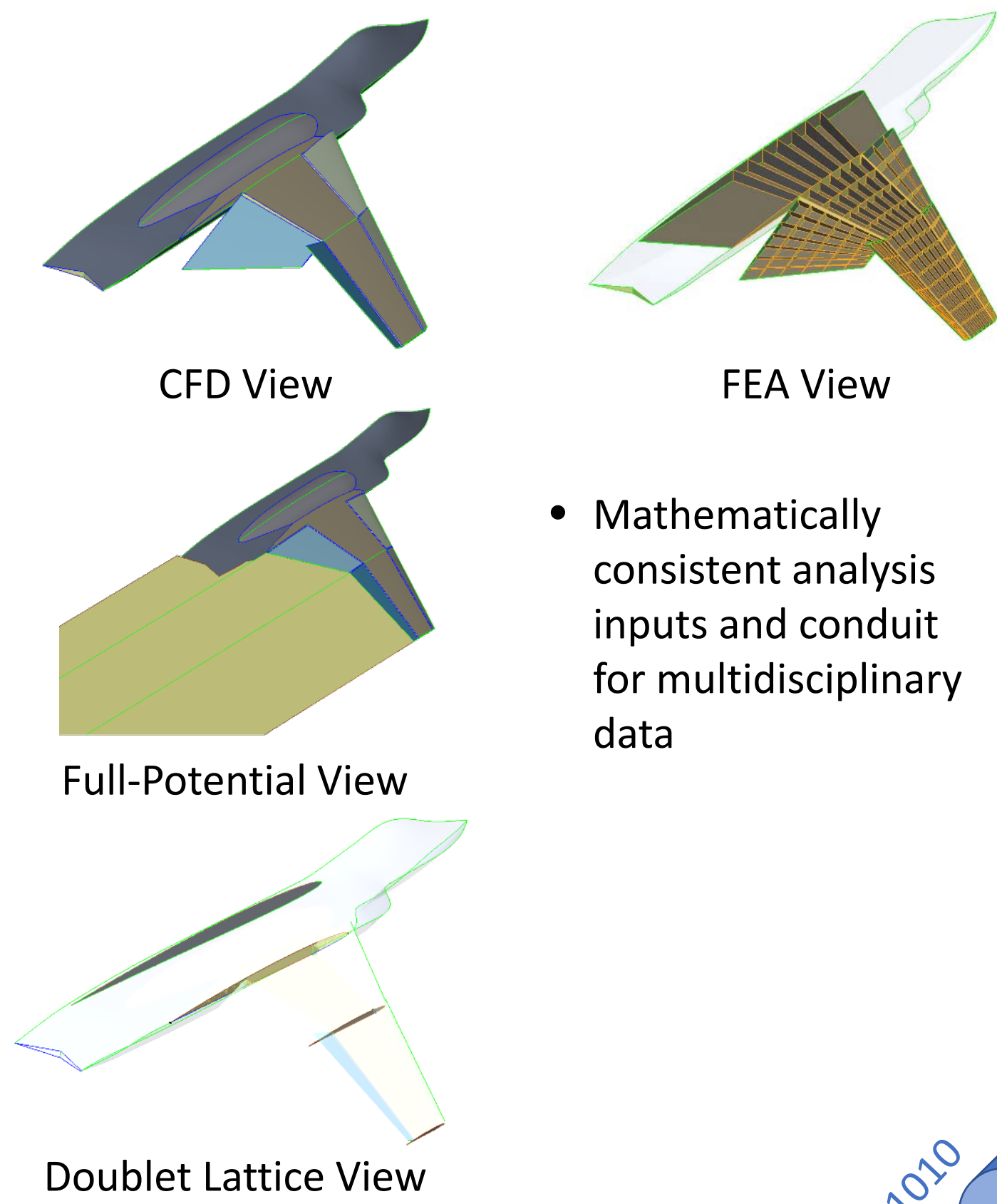
Geometry construction

esp

Engineering Sketch Pad

Available at acdl.mit.edu/ESP

Linking to analysis

caps

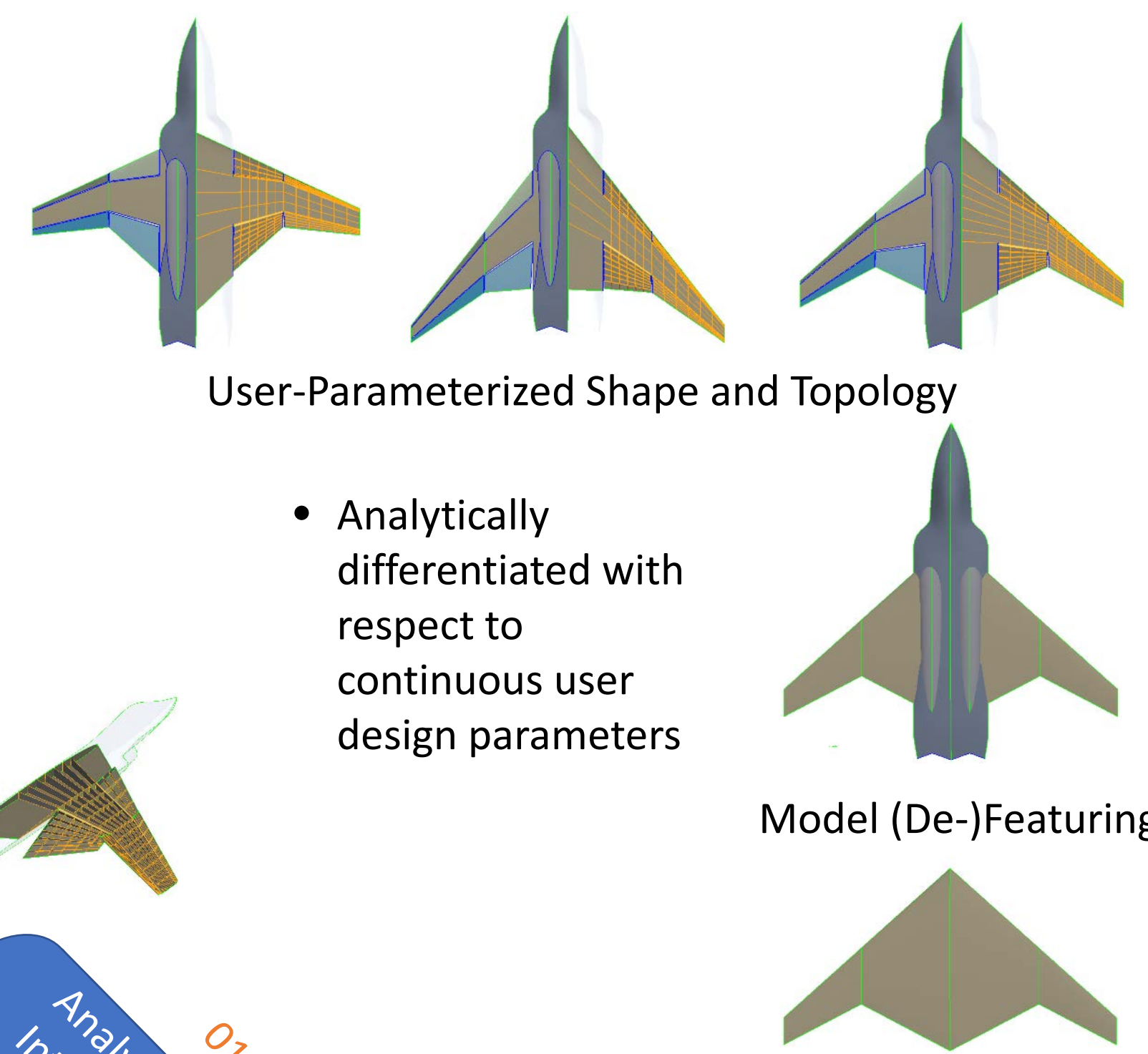Computational Aircraft Prototype Syntheses

Use-specific geometry views…
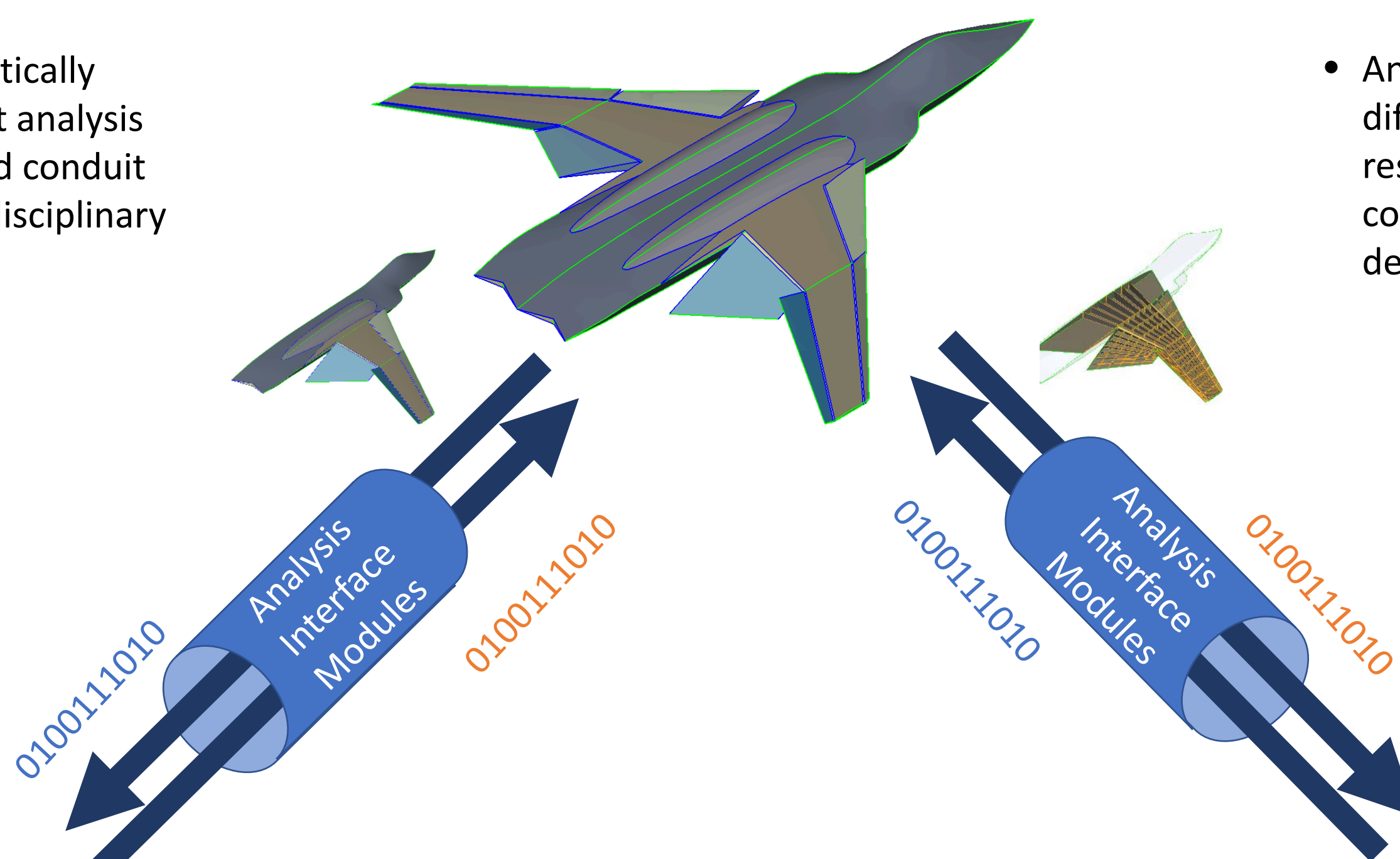

CFD View

FEA View

Full-Potential View

Doublet Lattice View

- Mathematically consistent analysis inputs and conduit for multidisciplinary data

Driven by parametrization…

User-Parameterized Shape and Topology

- Analytically differentiated with respect to continuous user design parameters

Model (De-)Featuring

Analysis Interface Modules
0100111010

Analysis Interface Modules
0100111010

Attributed for automation

- Interpretation into analysis inputs by Analysis Interface Module plug-ins

Component Identification

Meshing Controls

Analysis Properties

Bryson, D. E., Haimes, R., and Dannenhoffer, J. F., III, "Toward the Realization of a Highly Integrated, Multidisciplinary, Multifidelity Design Environment," AIAA SciTech 2019, AIAA 2019-2225