

DESIGN	ADVANCED ANALYSIS	OPTIMIZATION	MANUFACTURING	TESTING
Composites Metallics Etc.	Composites Metallics Etc.	Multidisciplinary Optimization	Custom Tooling Jigs and Fixtures Composite Molds	Sub-Scale and Full-Scale Structural Testing
Structural Mechanical Aeronautical	FEA Loads and Dynamics Structural Mechanical Mechanisms	Weight Reduction	Full-Vehicle Prototyping and Full-Scale Composite Builds	Ground and Flight
Tooling Jigs and Fixtures Assembly Tools	CFD Aeroelasticity Flutter	Trade Studies	Large-Scale Composite Manufacturing	NDI
DFM DFA	Thermal Analysis	Topology Optimization	Machining Trimming Painting Finishing	Coupon Testing to Support Allowables Development
Geometric Dimensioning & Tolerancing	Electronics Cooling	System Optimization	Additive Manufacturing	Unconventional Testing

SIEMENS
Partner

NX CAD

NX Manufacturing

Teamcenter PLM

Simcenter
Simulation

Training
and Mentoring



Experts in
Composites



Multidisciplinary
Expertise



65 ft 5-Axis
Gantry Mill



Partnership
Focused

Manufacturing Services Overview

Facilities

Long Beach, CA (13,500 sq ft)

Maricopa, AZ (20,000 sq ft)

Manufacturing Equipment

65 ft x 18 ft x 10 ft 5-axis gantry mill

10 ft x 4 ft x 3 ft 4-axis gantry router

3-axis CNC

5ft x 36ft autoclave

27ft x 12 ft x 10ft oven

10ft x 8ft x 5ft oven

Faro laser tracker

Composite Manufacturing

Custom tooling

Prepreg, wet layup, & infusion

Composite molds

Full-vehicle prototyping

Full-scale composite builds

Jigs & fixtures



65ft x 18ft x 10ft 5-axis Gantry Mill



Oven: 27ft x 12ft x 10ft



Autoclave: 5ft x 36ft



Prototype Tools



Production Tools



Fixtures and Jigs



Composite Parts



CNC Trimming



Assemblies and Airframes

Engineering Services Overview

50+ Engineers

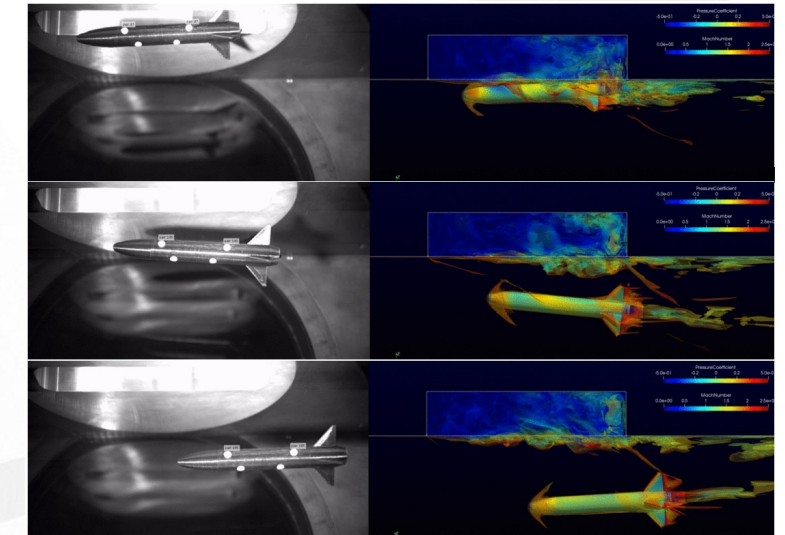
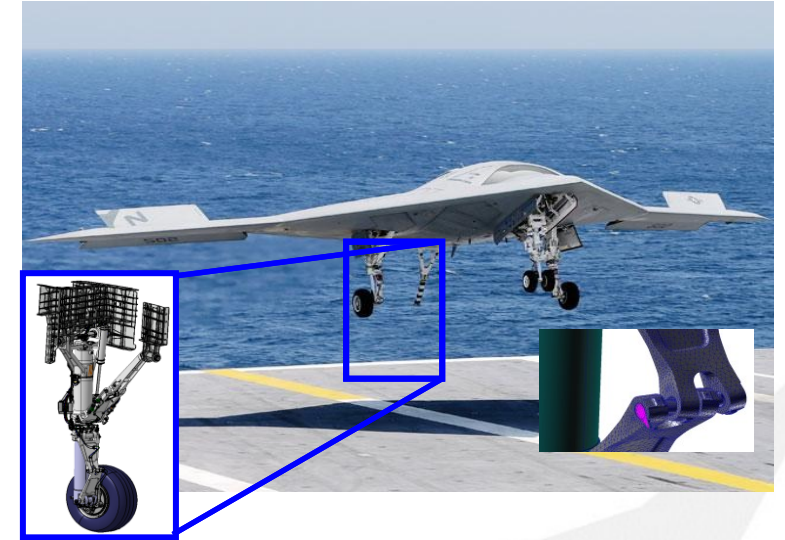
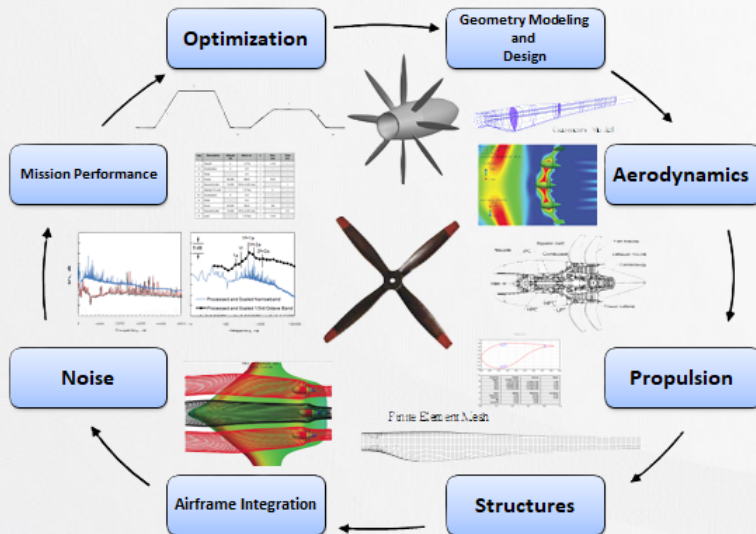
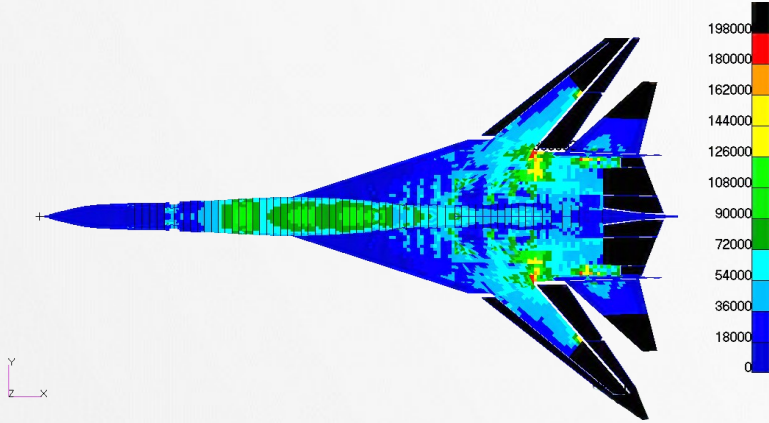
Designers
Analysts
Program Managers
On-Site Support

Design Expertise

Composites & Metallics
Structural
Aeronautical
Mechanical
Tooling
DFM / DFA
GD&T

Analysis & Simulation

Composites & Metallics
FEA
Loads & Dynamics
Structural / Mechanical
Mechanisms
CFD
Aeroelasticity & Flutter
Thermal
Electronics Cooling



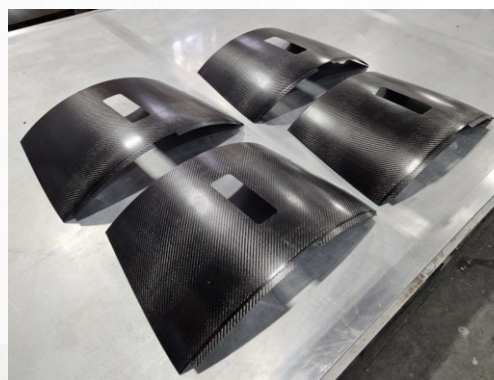
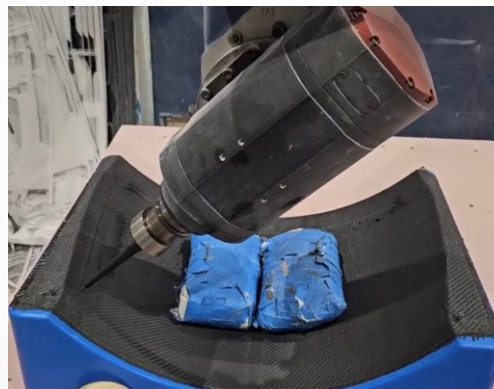
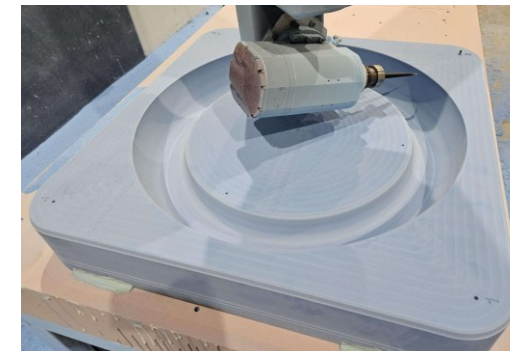
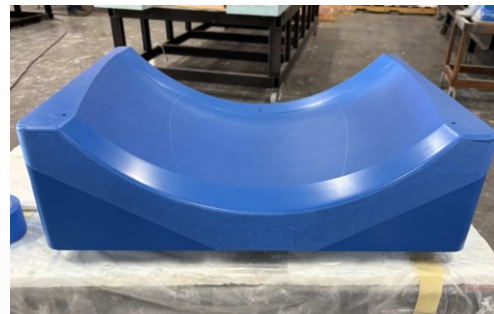
- **Full Development Capability**

- Concept design
- Aero, structural, propulsion design, and simulation
- Assembly planning
- Tooling design and production
- Metal and composite part fab
- Fastened and bonded subassemblies
- Wire harness, propulsion and power, and flight controls
- Landing gear
- Paint and finish
- Flight test support



Build #2 - Start to Finish in 66 Days

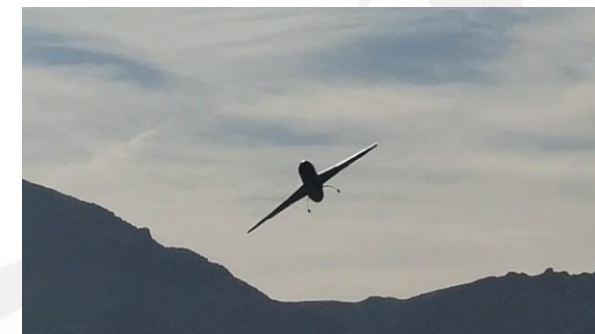
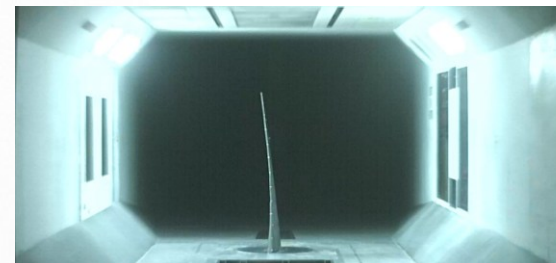
- DFM support: Transitioned conceptual CAD into manufacturing-ready tooling designs
- 5-axis CNC machined composite tooling boards to final geometry (*top right*)
- Prepared and finished tooling for composite layup (mold-ready state) (*top left*)
- Performed composite laminate layup per client's & manufacturers specification (*middle right*)
- Demolded and inspected composite parts
- Performed 5-axis CNC trimming and hand trimming of composite parts (*middle left*)



Inlet Bell

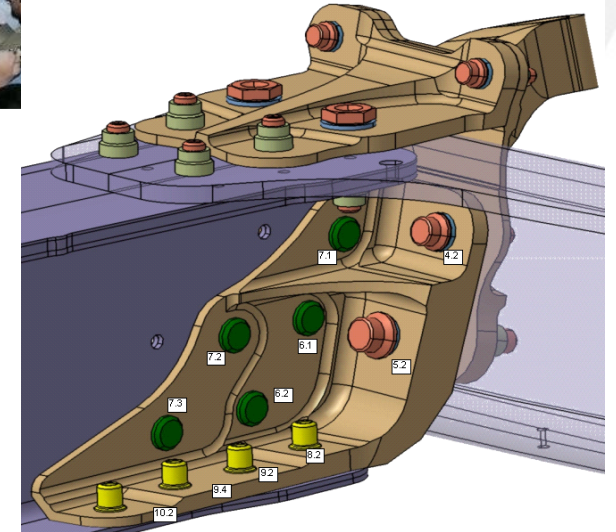
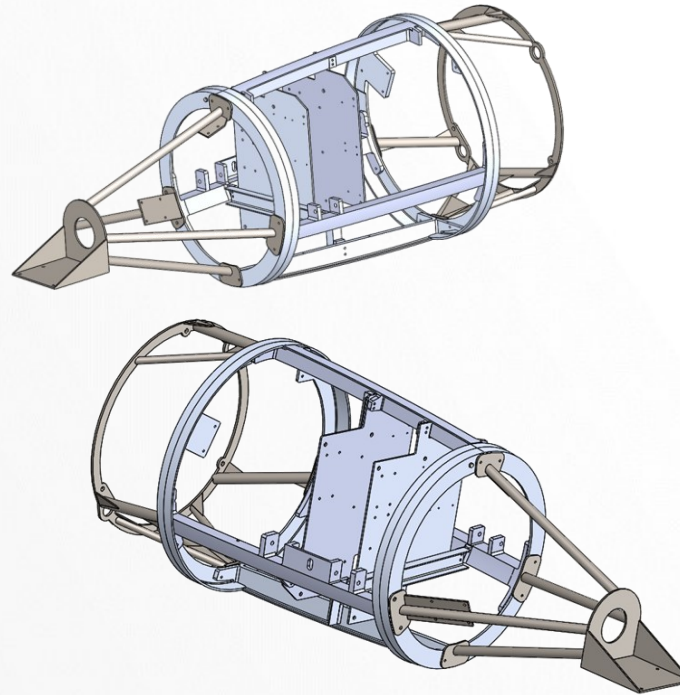
Aft Exterior Panels

- Designed and analyzed a scaled unmanned fixed-wing aircraft in collaboration with NASA's Armstrong Flight Research Center
- Integrated strain gauges into wing structures to collect static and in-flight load and deflection data
- Performed static wing bend testing to correlate applied loads, strain measurements, and structural deflections
- Developed finite element models and applied NASTRAN-based scaling methods to predict full-scale structural behavior
- Conducted wind tunnel testing to validate analytical predictions and strain data correlations
- Modified an off-the-shelf RC aircraft to validate wing design concepts and avionics integration
- Fabricated two 12-ft wingspan flight demonstrators using foam-core/fiberglass and carbon-fiber composite construction
- Successfully flight-tested composite demonstrator and collected in-flight strain data to validate analysis and design assumptions

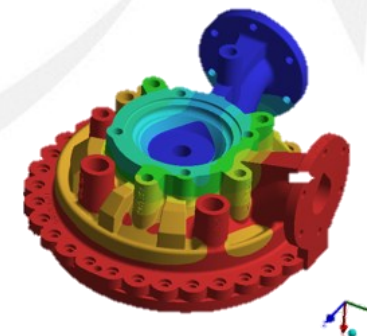
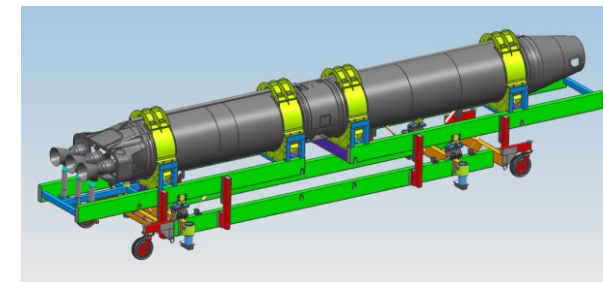
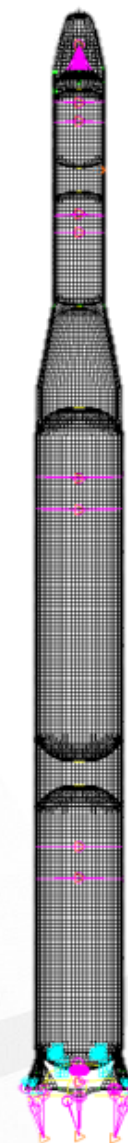


Structural Design

- Structural Design
 - Initial sizing and optimization
 - Requirements definition and flow down
 - DFMA
- Metallic and Composite Structures
 - Material selection
 - Layup definition
 - Work instructions
- CAD
 - SolidWorks
 - NX
 - CATIA
 - Creo
- 2-D Drawings
 - GD&T



- **Rocket Injector Structural Analysis**
 - Detailed stress analysis on rocket injector components to assess structural margins, identify high-stress regions, and support injector design refinement under operating loads
- **Injector Conjugate Heat Transfer (CHT) Analysis**
 - Coupled flow and thermal analysis of injector and feed systems to evaluate heat transfer and temperature-driven effects
- **Pipe Flow Network Analysis for Injector Uniformity**
 - Modeled injector feed plumbing to assess pressure drop and flow distribution, ensuring uniform spray patterns at injector outlets
- **Random Vibration Analysis of Propulsion Plumbing**
 - Analyzed random vibrate response of plumbing near engines and thrusters to assess dynamic loads and structural integrity
- **Vehicle Loads Analysis**
 - Developed vehicle-level loads (quasi static and dynamic cases) to define critical environments for propulsion and structural hardware
- **Vehicle-Level CFD Analysis**
 - To characterize aerodynamic pressures and feed resulting loads into structural evaluations
- **Ground Support Equipment Design – Transportation Cart**
 - Designed and structurally analyzed the rocket transportation cart used to move the vehicle from facility to launch site, including static and dynamic loads
- **Composite Interstage Fabrication**
 - Designed and built composite tooling, fabricated carbon fiber parts, and assembled the vehicle interstage structure

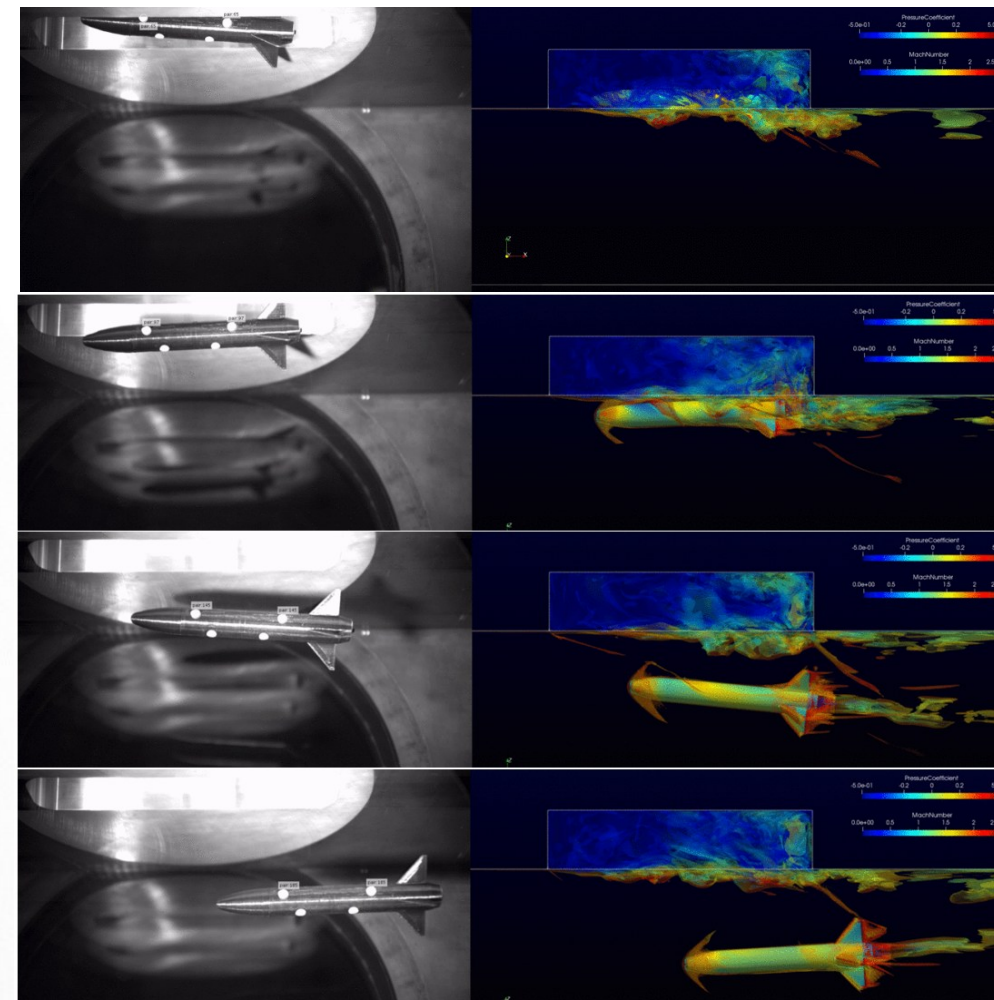




- Developed a computational tool for evaluating the effects of unsteady loading on store trajectories (prime contract FA8650-14-C-2527).
- Combined wind tunnel testing and CFD analysis to characterize stores, weapon bays, and ejector configurations (image on the right).
- Wind tunnel experiments included empty cavity, captive store, and free store ejection.
- CFD simulations included empty store, stationary store, and trajectory simulations with both explicit 6-DOF/CFD coupling and with the RUSAT tool.
- Data enables computation of a range of parameters indicating likelihood of a user specified configuration being adversely affected by steady and unsteady aerodynamics
- Enabled rapid screening of store separation characteristics. Reducing analysis time and focusing detailed testing on higher-risk configurations

Client: Air Force, Air Force Research Lab (under prime contract FA8650-14-C-2527)

Date of Completion: June 2021



(Left) Wind tunnel free drop

(Right) Time accurate CFD DES simulation result used for training surrogate models

- Design feasibility for early concept phases
- Supported tilt-rotor and lift-plus-cruise configurations
- Defined critical flight load cases for takeoff and cruise
- Built parametric weight models from first principles
- Modeled structural components (booms, hinges, ducts)
- Developed low-order beam models for eVTOL structures
- Automated FEM generation for quick analysis
- Structural design of Uber eCRM-001 & eCRM-002
- Physics-based sizing and weight trade studies
- Integrated structural design with performance models
- Vehicle-level structural optimization
- Provided simulation data for key design decisions

