



University of Dayton
Research Institute

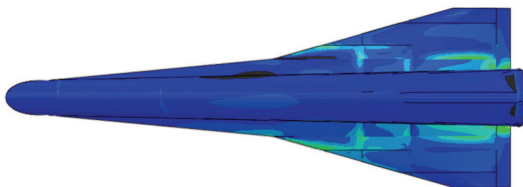
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► CAPABILITIES

HYPERSONIC MATERIALS & STRUCTURES

Multi-disciplinary design and development from concept through flight test

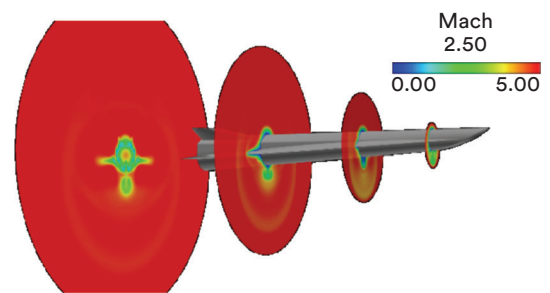
INTEGRATED APPROACH

UDRI offers a breadth of capabilities in hypersonic vehicle materials and structures, with engineers and scientists specializing in a wide range of hypersonics-related fields. This allows us to perform multi-disciplinary design and development of hypersonic structures from concept through flight test. Key capabilities include design and analysis, material processing, and experimental testing as outlined below and utilized in selected recent projects. UDRI maintains a strong network within the hypersonics community including government, industry, and academia partners, and our not-for-profit status allows us to perform objective technology assessments and efficient technology insertion.



DESIGN & ANALYSIS CAPABILITIES

- Trajectory analysis and optimization using DOF36 and commercial codes
- Computational fluid dynamics analyses using panel, Euler, and RANS codes
- Conceptual and detailed designs using SolidWorks® solid modeling software
- Structural, thermal, and dynamic analyses using the Abaqus® finite element code
- Exploration of unique composite fiber architectures using UDRI's VTMS tool
- Thermo-mechanical behavior of composites using UDRI's BSAM code

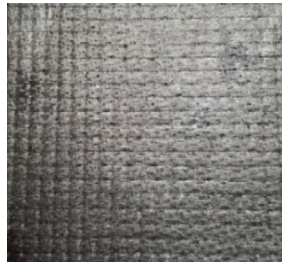


RECENT PROJECTS

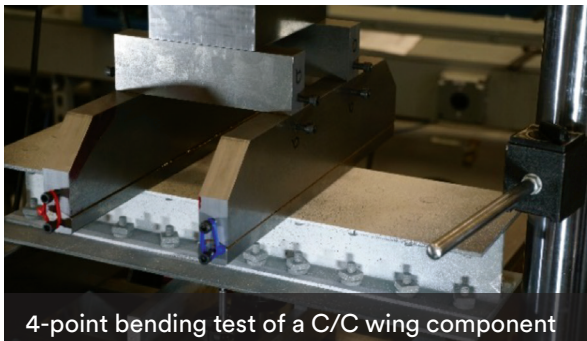
- Structural integration of high temperature composite components
- Design and analysis of reusable hypersonic vehicle structures
- Development of hypersonic flight research vehicle structural payload
- Joining of dissimilar materials for hypersonic vehicle applications
- Unit cell modeling of ceramic matrix composite processing
- Fabrication of high temperature C/C, C/SiC, and SiC/SiC composites
- Development and improvement of NDE techniques to assess CMC integrity
- Ultrasonic measurement of modulus and residual stress at elevated temps

MATERIALS PROCESSING CAPABILITIES

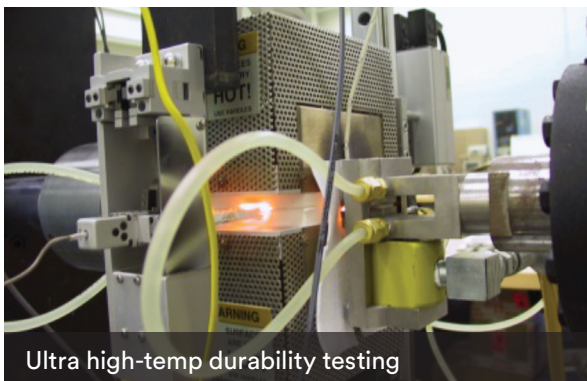
- Production of C/C, C/SiC, and other ceramic matrix composites (CMCs)
- Advanced composite fabrication using tailored fiber placement and stitching
- Rapid prototyping, including AM, of polymer, metallic, and ceramic structures
- Full-service machine shop for test article and fixture fabrication
- NDI techniques including X-ray, eddy current, ultrasound, and thermography



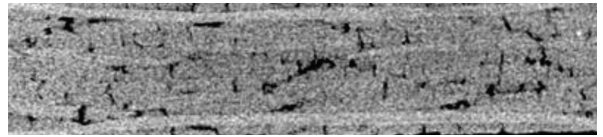
UDRI-manufactured conventional and TFP stitched C/C and C/SiC composites



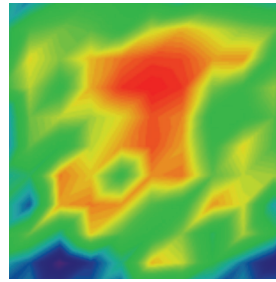
4-point bending test of a C/C wing component



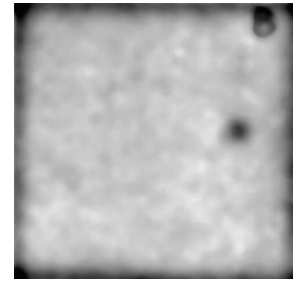
Ultra high-temp durability testing



X-Ray CT



Ultrasonic



Thermography

EXPERIMENTAL TESTING CAPABILITIES

- Over 20 universal test frames ranging from 5 to 550 kip capacity
- Materials characterization testing at temperatures up to 2,700°F
- Custom multi-axial testing of large assemblies including multiple T-slot bedplates and reconfigurable floor space
- Up to 50 foot high bay to handle tall test articles
- Limit and ultimate load static strength evaluation
- Thermal-mechanical fatigue testing at frequencies ranging from 0.001 to 1,000 Hz
- State-of-the-art machine controllers for multi-axis control and data collection
- Wide variety of instrumentation and data acquisition schemes
- Digital image correlation for full-field strain and displacement measurements
- Broad vibration test capabilities including shakers up to 5,000 lb
- Specialty structural testing, including low-velocity and ballistic impact
- Complete fractographic capabilities for test article teardown analysis