National Aeronautics and Space Administration

NASA Ames Research Center
Imaging Diagnostics at the Unitary Plan Wind Tunnel

Illuminate the Physics Your Sensors are Missing

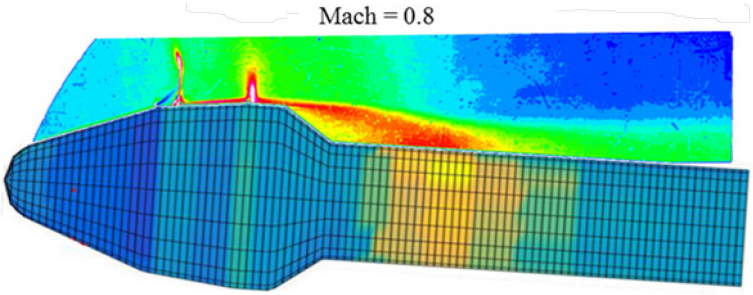
Uncover the aerodynamic phenomena that simulations can miss and static transducers can't resolve.

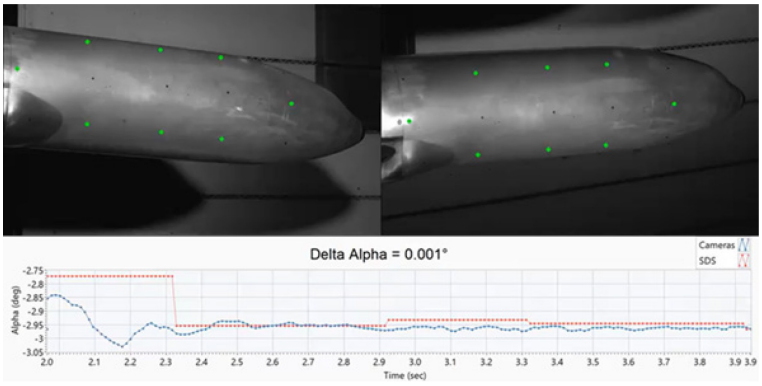
Traditional Data Meets Modern Cameras

Traditional wind tunnel instrumentation like force and moment balances, pressure transducers, and acoustic measurements provide the "what" – the quantitative values at specific points. The "why" often exists in the spaces between your model sensors. Flow visualization transforms your wind tunnel entry from a data-collection exercise into a diagnostic discovery mission.

Why Choose Flow Visualization?

- Inform CFD Validation: Provide insight that your mesh is capturing the real-world.
- Identify Interference: See how stores, control surfaces, and high-lift devices interact with the vehicle flow.
- Eliminate Ambiguity: Resolve conflicting sensor data by seeing the physical flow structures in real-time.
- Unique Insight: Capture flow phenomena otherwise hidden, including laminar flow on complex geometries.





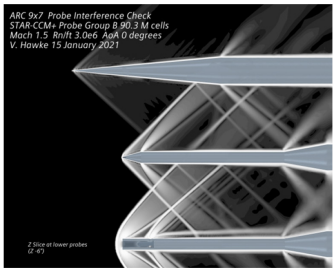
Imaging Techniques

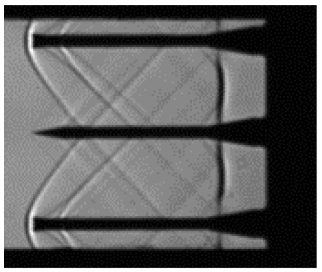
- High-Speed Shadowgraph
- Infrared Thermography
- Optical Model Attitude
- Model Deformation Measurements
- Pressure-Sensitive Paint*
- Particle Image Velocimetry*

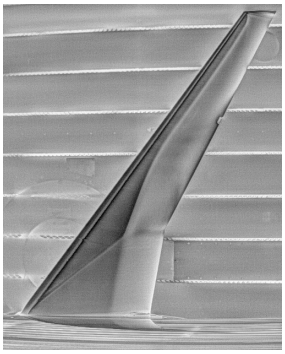
*System information upon request

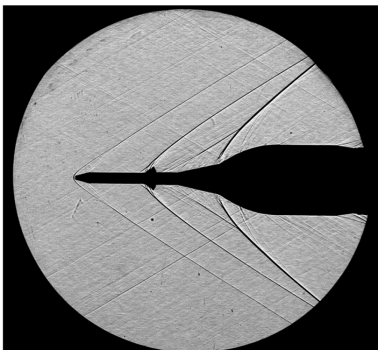
Techniques may provide information on a variety of flow:

- Shock shape & formation
- Flow separation
- Boundary layer transition
- Laminar or turbulent flow
- Buffet
- Shock impingement
- Vortex footprint/vortex shedding
- Wake characteristics
- Visualize acoustic frequency content
- Fluid-structure interaction between on and off body flow



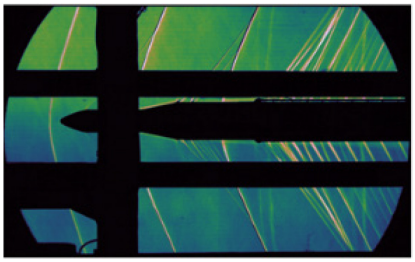






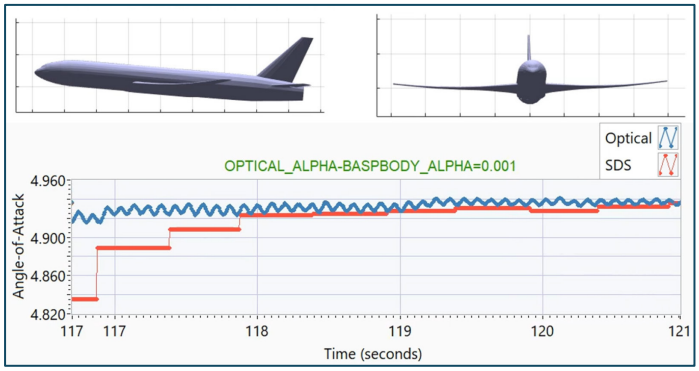
Shadowgraph Overview

Flow	- Model shockwave formation and interaction - Flow separation - Mach wave radiation
Cameras	1x low-speed; 1x high-speed
Frames Per Sec	20 (low-speed); 51,000 (high-speed)
Model Prep	None
Data Acquisition	- Coincident with standard tunnel measurements - Real-time displays available
Data Products	- MP4 movies - Still images TIFFS - Variance and frequency analysis (high-speed)



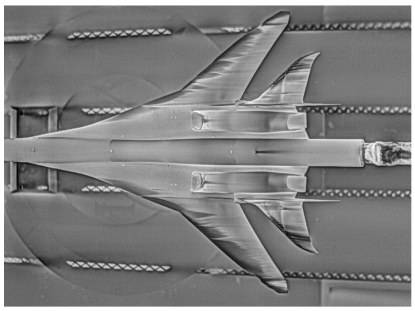
Optical Model Attitude (OMA) Overview

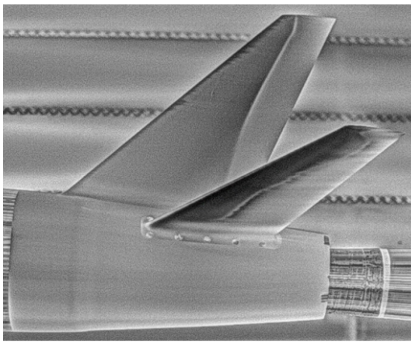
Measurement	- On going development of the system - A camera-based model attitude measurement - Six degree of freedom motion capture
Cameras	2x
Frames Per Sec	120 (default)
Model Prep	Painted targets
Data Acquisition	Continuous while tracking model with real-time display
Data Products	Time histories of angle of attack, sideslip, and roll based on camera measurement



Infrared Thermography Overview

Flow	- Boundary layer transition - Shock impingement - Vortex footprint - Flow separation - Buffet
Cameras	4x Midwave IR; Spectral Range 3.0 – 5.0 μm
Frames Per Sec	20 (default)
Model Prep	- Black Paint + epoxy layer (~3 thou) - Sanded finish supports laminar flow
Data Acquisition	- Coincident with standard tunnel measurements - Real-time displays available
Data Products	Per camera view: - MP4 movies - Still images TIFFS





Don’t leave the tunnel with more unanswered questions. Contact us to discuss optics support on your next entry.

Contact Information
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