



NASA Advanced Supercomputing (NAS) and Unitary Plan Wind Tunnel (UPWT) Facility Integration

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NASA Ames Facilities



Unitary Plan Wind Tunnels

<https://www.nasa.gov/nasa-ames-unitary-plan-wind-tunnel/>

NASA Advanced Supercomputing (NAS) Division

<https://www.nas.nasa.gov/>





Sept 2019: Linking UPWT and NAS Facilities

Pilot project to link the facilities for unsteady pressure sensitive paint (uPSP) experiments

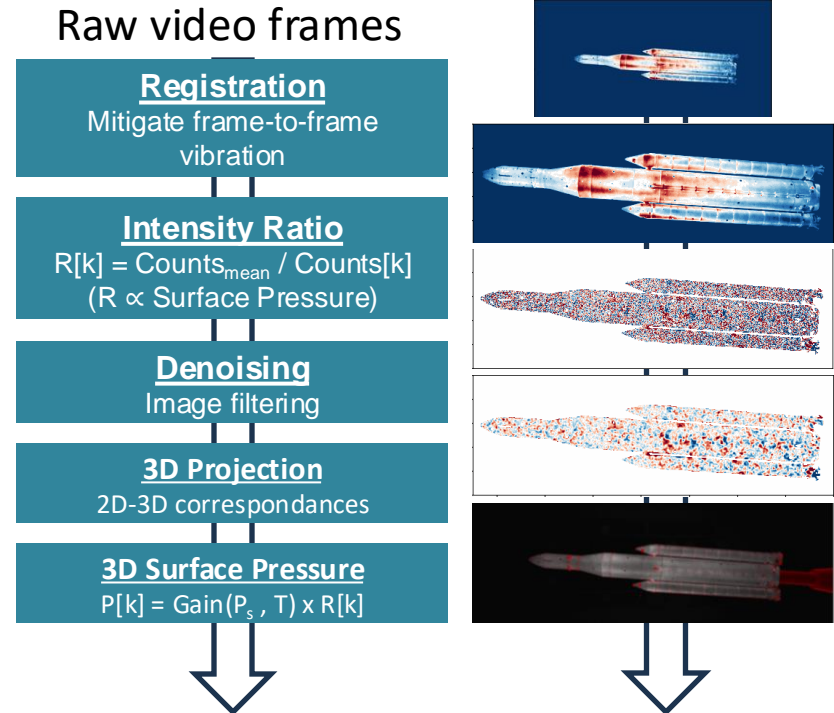
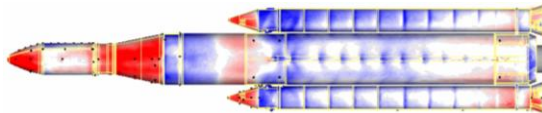
- Test objective: Demonstrate the capability to move test data from the UPWT to NAS and perform timely data reduction
- Test outcome: Test results were transferred and processed in minutes (previously took months).
 - Customer engineers were able to view physical flow features and investigate areas of interest in near real-time
 - Potential to identify “bad” data points during the test campaign
 - Presented possibility of updating test plan during the campaign based on specific areas of interest/disinterest



Unsteady Pressure-Sensitive Paint at NASA

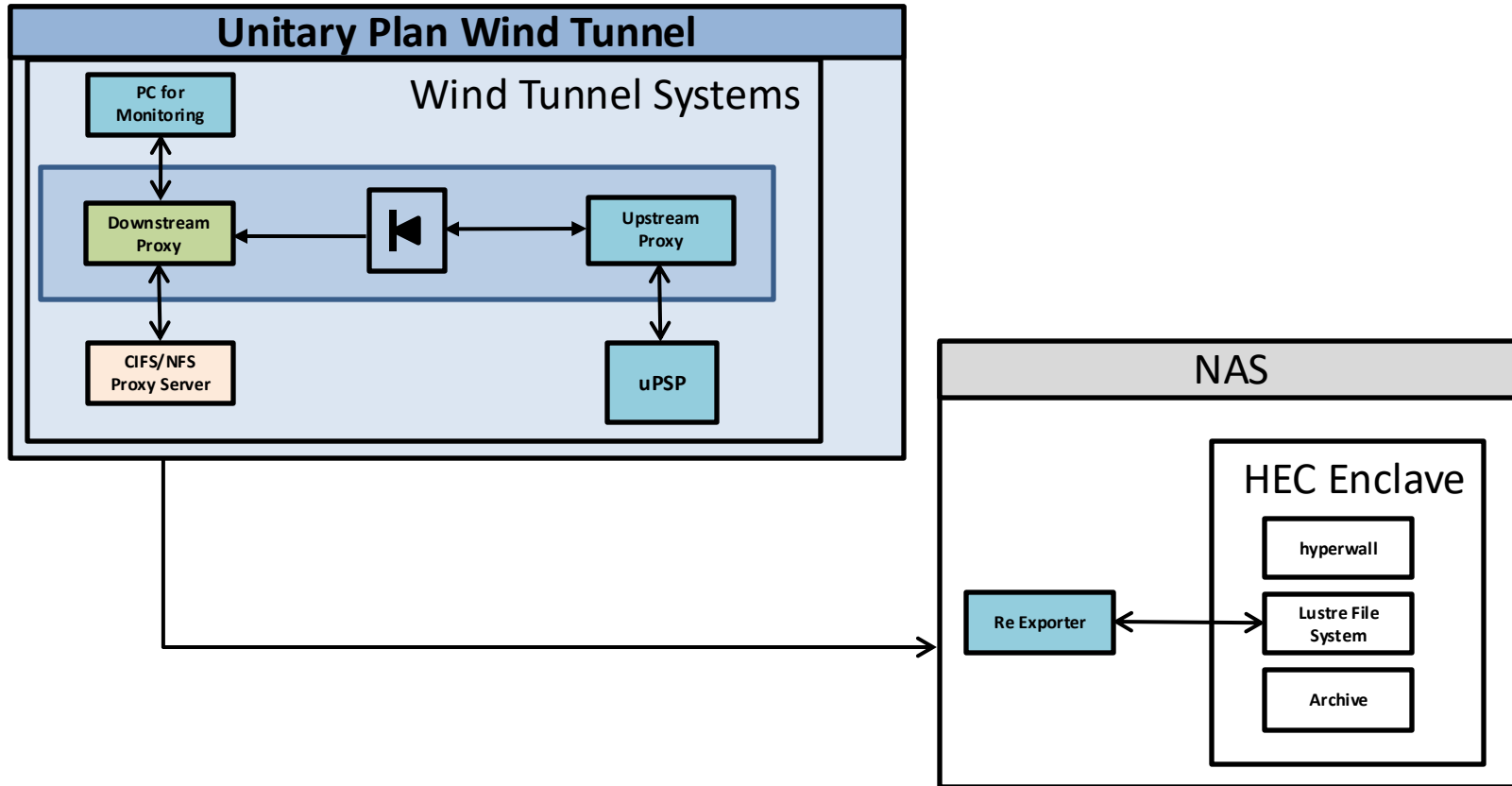
Data Acquisition → Data Transfer → Data Processing

- uPSP is a technique to record unsteady pressures on the surface of aerospace vehicles
- Model is treated with a surface coating that changes luminance with surface pressure
- Model is illuminated at a specific wavelength during the wind tunnel test
- Surface response is captured by a series of high-speed cameras





Facility Connectivity and Data Transfer

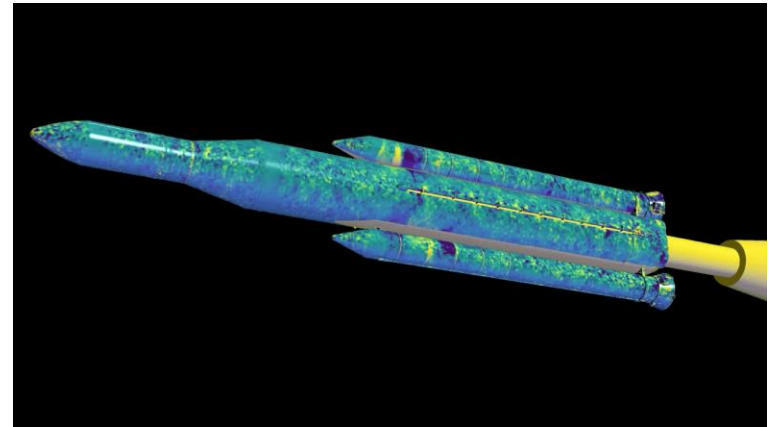




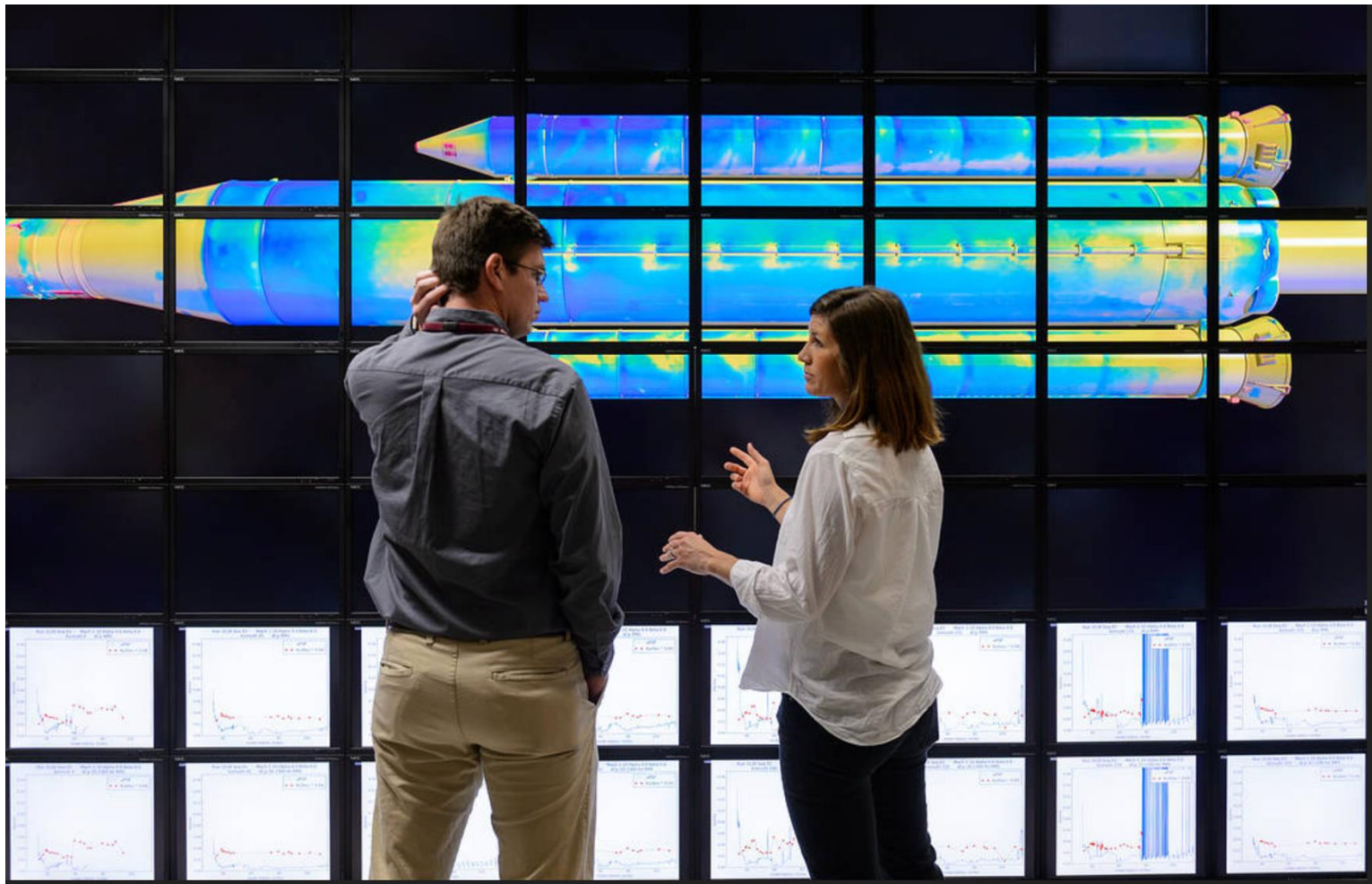
Near-real-time Processing of Unitary Wind Tunnel Data on the Ames hyperwall

- NAS Visualization team provided significant, custom support for the live data transfer from the SLS transonic buffet test in the NASA Ames 11-ft Unitary Wind Tunnel, for near-real-time processing and display on the hyperwall—reducing customer access time from months to minutes.
- The 2.5% SLS model is covered with pressure sensitive paint, and the raw data are images showing its response over 5–10 seconds, at 10,000 frames per second, from each of four cameras. During a week of testing, such exposures at 800 test conditions produced about 160 terabytes data.
- The primary data processing used computer vision techniques to convert 2D pixel intensities into pressure values on the surface of the 3D model. The Visualization group reduced this processing time from one day per test point to one minute, using massive parallelism on NAS supercomputers.
- The near-real-time availability of results provides unprecedented opportunities to confirm data quality and to detect unforeseen behavior—while the test is still running in the wind tunnel—allowing corrective action and guiding further data acquisition.

IMPACT: Coupling Ames wind tunnels with Ames supercomputers enables near-real-time data analysis, giving customers opportunities for timely corrections, data-guided exploration, and more efficient use of these expensive test facilities.



Visualization showing averaged pressure distribution on the surface of a model of the SLS in the NASA Ames 11-ft Unitary Wind Tunnel, as revealed by inline analysis of unsteady pressure sensitive paint streaming image data. *Chris Henze, NASA/Ames*





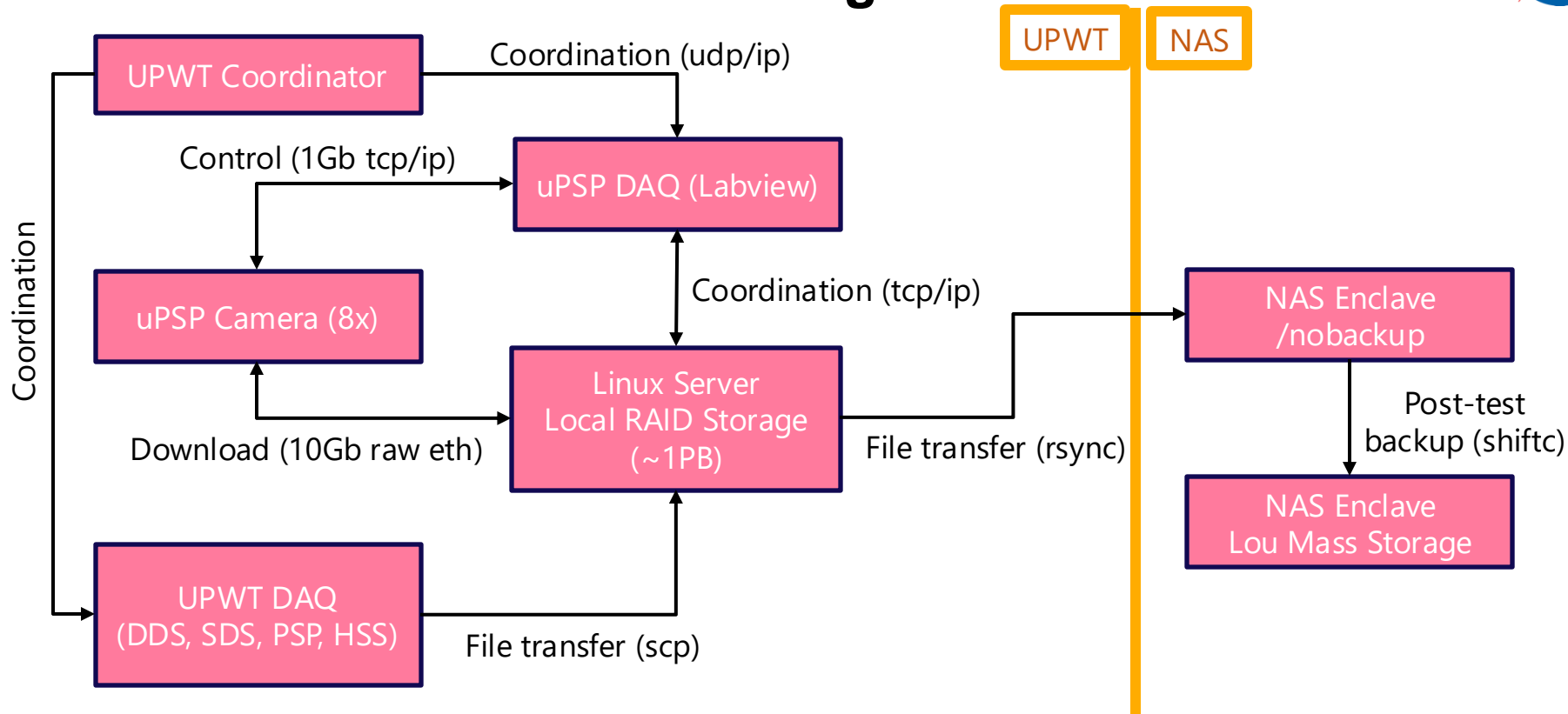
May 2024: Linking UPWT and NAS Facilities

Next generation proof of concept test

- Test objective: Demonstrate evolved data acquisition/transfer system and establish operational requirements for future tests
- Test outcome: Test data was transferred from UPWT to NAS but no data reduction was planned
 - New systems were successfully deployed and vetted
 - Established best practices and resource requirements for operational capability
 - Identified need to reassess data transfer requirements



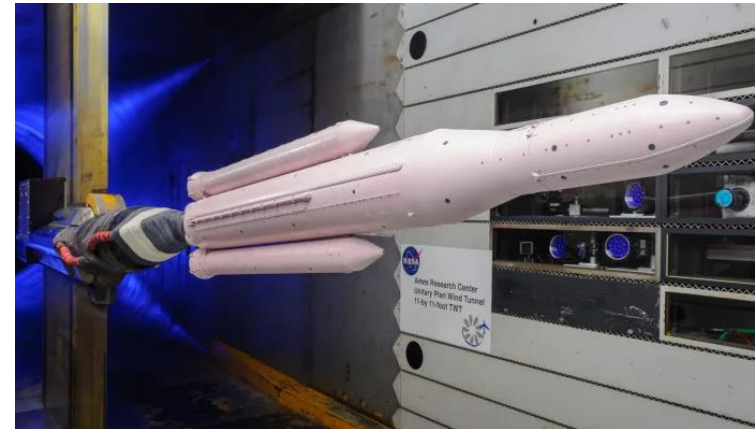
Data Management



HECC Supports Unitary Plan Wind Tunnel

- With support from HECC, the NASA Ames Unitary Plan Wind Tunnel (UPWT) team successfully performed initial large-scale testing of the Unsteady Pressure Sensitive Paint (uPSP) application, culminating a multi-year, complex project called Red Rover.
- The HECC Systems and Security teams, along with the NASA Advanced Supercomputing (NAS) Division Research & Development team and the UPWT team, jointly developed and deployed the complex data streaming and analysis system, which performed as expected during the first full wind tunnel test.
- The test streamed data from wind tunnel cameras to the UPWT data cache system, from which sensor data flowed to the NAS facility for further analysis and evaluation in the HECC environment.
- The work enables the UPWT team to leverage the agency's high-end computational, storage, and visualization capabilities efficiently and in two modes: coupled mode, which collects test results and sends those results to the NAS facility in near-real-time, or standalone mode, which collects test results and copies those results to NAS at a later time.

IMPACT: Coupling the physical wind tunnel facility with the NAS facility to stream sensor data to the HECC enclave and data visualization environment may enable rapid analysis of results and potentially assist in driving experimentation in real time.



The Space Launch System model in the 11-by 11-foot TWT Wind Tunnel facility. *Dominic Hart, NASA*



Feb 2025: Linking UPWT and NAS Facilities

Customer test is scheduled for early 2025

- Test objective: Operationalize the uPSP data acquisition, transfer and reduction
- Work to be done prior to the next test
 - Revisit the data transfer requirements
 - Re-establish the data processing workflow on the new NAS hyperwall
 - Work with customer engineering teams to identify high-value visualization requirements

