

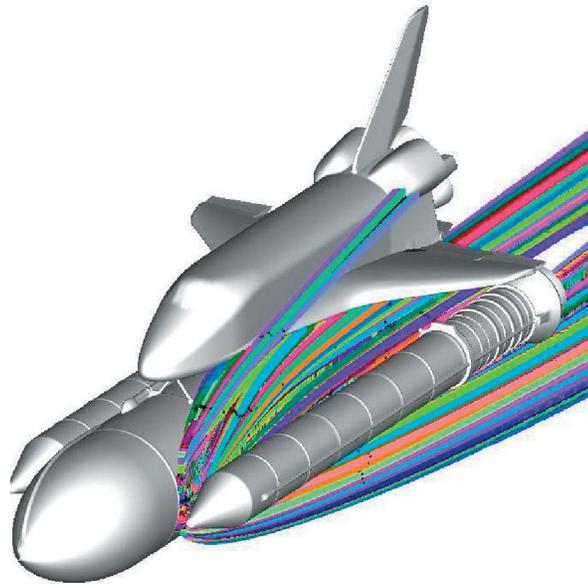
## NASA Ames Contributions to Return to Flight

After the loss of the space shuttle Columbia and crew on Feb. 1, 2003, NASA engineers and scientists turned their grief into a determined resolve to prevent a repeat of the tragic accident and to return the shuttle to safe flight.

For the past three years, NASA has tapped the wealth of knowledge and expertise within the agency to ensure the space shuttle's flight worthiness, astronaut safety and develop plans for in-flight contingencies ranging from minor tile damage to a major structural breach.

NASA Ames Research Center, located in California's Silicon Valley, is playing a vital role in the in NASA's space shuttle program.

NASA Ames personnel and facilities are involved several key aspects of the program, from the analysis of new space shuttle system designs to development of in-flight analysis tools; from improvements in thermal protection durability and repair to the analysis of large data sets used in



Plot of several trajectories depicting the path of debris shed from the External Tank generated by the Columbia.

ties meld the expertise acquired through decades of aerospace research and development with cutting-edge information technology and unique facilities.

Computational fluid dynamic (CFD) models are helping NASA develop design modifications to space shuttle systems, characterize debris flow patterns and understanding the conditions the shuttle's thermal protection system experiences during re-entry. The CFD models are being created and validated using a refurbished three percent space shuttle model in the center's 9-foot-by-7-foot supersonic wind tunnel. The model was built during the development of the original space shuttle design in the 1980s. NASA Ames' ballistic gun range, originally used in the past to develop Apollo capsule designs, was used to develop debris trajectory CFD models.

In preparation for the STS-121 flight, NASA Ames tests determined the aerodynamic effects on key shuttle components with the removal of the liquid hydrogen and liquid oxygen Protuberance

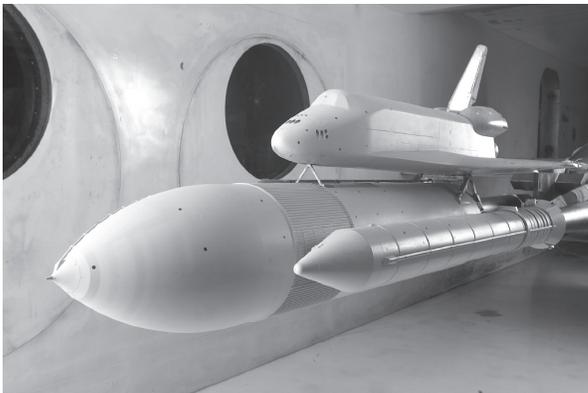


Photo of the 3 percent wind-tunnel model of the Space Shuttle in the NASA Ames Unitary Wind Tunnel.

complex simulations by one of the world's fastest supercomputer, the Columbia supercomputer.

The NASA Ames space shuttle effort taps into the center's critical core capabilities in computational fluid dynamics, information technology and thermal protection systems. These core capabili-



Repair panel heated in the arc jet stream of the NASA Ames Interaction Heating Facility.

Air Load (PAL) ramps. The tests also increased NASA's understanding of the forces exerted on the external tank foam including the unexpected areas of foam shedding on the STS-114 flight.

Using the center's Columbia supercomputer, engineers and scientists are compiling and analyzing the tremendous amounts of data collected from tests at Ames and at other NASA centers. Using this capability, NASA simulated various pre-launch, ascent, on orbit and descent conditions. Columbia simulated the trajectory of the foam shed on the STS-114 flight, increasing NASA's understanding of the behavior of foam debris. The Columbia super computer has simulated 60 shuttle scenarios using more than

100,000 computational hours. The speed of the computer continues to allow NASA to create and analyze simulations in a fraction of the time previously required. Other information technology expertise is helping NASA gather, organize and analyze information before, during and after space shuttle operations and monitor vehicle health.

As a recognized leader in thermal protection systems, Ames continues to use its expertise to develop increasingly durable thermal protection systems (TPS) and on-orbit TPS repair systems. Concepts for fixing cracks or holes include plugs (cover plates), patches (pre-ceramic polymers impregnated cloth) and paste-like materials (pre-ceramic polymers) are being assessed for effectiveness in the NASA Ames arc jet facility at up to 3000 degrees Fahrenheit to simulate re-entry conditions.

NASA Ames continues its integral role to provide on-going technical, scientific and engineering support for the space shuttle program. NASA Ames will continue to provide the critical data shuttle managers need during before, during and after a mission. NASA Ames personnel and facilities stand ready for the analysis of any in-flight situation and NASA's mission to explore the moon, Mars and beyond.