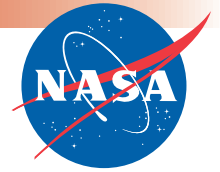


# SPACE LAUNCH INITIATIVE

## Technology Summary



### *Flight Mechanics*

Using the model of the network of nerves woven through the human body that sends messages without a person being conscious of them, engineers plan to build neural networks in future spacecraft that allow the vehicles – rather than the pilots – to think and act to solve problems.

This “adaptive system” is one of the flight mechanics technologies to be explored as part of NASA’s Space Launch Initiative for the guidance, navigation and control systems of a 2nd Generation reusable launch vehicle.

The Space Launch Initiative is NASA’s effort to reduce the risk associated with developing a 2nd Generation reusable launch vehicle by defining, developing and testing technologies needed to safely and cheaply access space. NASA’s goal is to significantly increase safety, improve reliability and reduce payload launch costs from today’s \$10,000 per pound to \$1,000 per pound.

The key to neural networking is programming algorithms in computer software so the algorithms actually learn from themselves. Each time the software experiences an opportunity to make a correction to a spacecraft during flight, that memory would be recorded for application in future similar situations.

This system would save engineers countless hours: No longer would they have to brainstorm every possible vehicle emergency scenario and then pre-program each scenario into the software. Safety would be improved because pilots could focus more on a mission’s purpose than on every detail of every on-board system.

For example, if an engine is not working properly, the software would instantly calculate solutions to correct thrust and implement the solution.

At the same time, such adaptive software would determine a vehicle’s trajectory during an anomaly. Variables such as speed and altitude would be reviewed, and the vehicle’s flight path corrected. This would include pointing the vehicle to the nearest landing strip in an emergency.

NASA will work in conjunction with the U.S. military – especially the Air Force – and university researchers already advancing these technologies to improve flight safety and reliability.

Another technology to be advanced is automatic rendezvous and docking systems. Space Shuttle crews currently use a partially manual system, but a fully automated system developed for SLI could prove to be more reliable and safer.

Currently, Shuttle pre-mission planning involves a considerable amount of time. Engineers must simulate multiple launch trajectories, calculating payload weights, wind and other atmospheric conditions to determine the safety parameters for each launch. SLI is tackling the challenge of defining new methods to speed up these calculations, reducing time involved, and ultimately operational costs.

The Marshall Space Flight Center leads the Space Launch Initiative with support from Ames Research Center in Moffett Field, Calif.; Stennis Space Center in Bay St. Louis, Miss.; Kennedy Space Center, Florida; Dryden Flight Research Center in Edwards, Calif.; Johnson Space Center in Houston, Texas; Langley Research Center in Hampton, Va.; the Jet Propulsion Laboratory in Pasadena, Calif.; Glenn Research Center in Cleveland, Ohio; and the Air Force Research Laboratory, which includes research and development facilities at nine United States Air Force bases nationwide.