Evolvable Neural Software System

Goddard Space Flight Center, Greenbelt, Maryland

The Evolvable Neural Software System (ENSS) is composed of sets of Neural Basis Functions (NBFs), which can be totally autonomously created and removed according to the changing needs and requirements of the software system. The resulting structure is both hierarchical and self-similar in that a given set of NBFs may have a ruler NBF, which in turn communicates with other sets of NBFs. These sets of NBFs may function as nodes to a ruler node, which are also NBF constructs. In this manner, the synthetic neural system can exhibit the complexity, three-dimensional connectivity, and adaptability of biological neural systems.

An added advantage of ENSS over a natural neural system is its ability to modify its core genetic code in response to environmental changes as reflected in needs and requirements. The neural system is fully adaptive and evolvable and is trainable before release. It continues to rewire itself while on the job. The NBF is a unique, bi-level intelligence neural system composed of a higher-level heuristic neural system (HNS) and a lower-level, autonomic neural system (ANS). Taken together, the HNS and the ANS give each NBF the complete capabilities of a biological neural system to match sensory inputs to actions. Another feature of the NFB is the Evolvable Neural Interface (ENI), which links the HNS and ANS. The ENI solves the interface problem between these two systems by actively adapting and evolving from a primitive initial state (a Neural Thread) to a complicated, operational ENI and successfully adapting to a training sequence of sensory input. This simulates the adaptation of a biological neural system in a developmental phase. Within the greater multi-NFB and multi-node ENSS, self-similar ENI's provide the basis for inter-NFB and inter-node connectivity.

This work was done by Lawrence Sparks, Attila Komjathy, and Anthony Mannucci of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-40930.

Prediction of Launch Vehicle Ignition Overpressure and Liftoff Acoustics

Marshall Space Flight Center, Alabama

The LAIOP (Launch Vehicle Ignition Overpressure and Liftoff Acoustic Environments) program predicts the external pressure environment generated during liftoff for a large variety of rocket types. These environments include ignition overpressure, produced by the rapid acceleration of exhaust gases during rocket-engine start transient, and launch acoustics, produced by turbulence in the rocket plume. The ignition overpressure predictions are time-based, and the launch acoustic predictions are frequency-based. Additionally, the software can predict ignition overpressure mitigation, using water-spray injection into the rocket exhaust stream, for a limited number of configurations.

The framework developed for these predictions is extensive, though some options require additional relevant data and development time. Once these options are enabled, the already extensively capable code will be further enhanced.

The rockets, or launch vehicles, can either be elliptically or cylindrically shaped, and up to eight strap-on structures (boosters or tanks) are allowed. Up to four engines are allowed for the core launch vehicle, which can be of two different types. Also, two different sizes of strap-on structures can be used, and two different types of booster engines are allowed.

Both tabular and graphical presentations of the predicted environments at the selected locations can be reviewed.