greedy search itself. Together this enables the use of highly-efficient partitioned-matrix-inverse techniques that result in large speedups of computation in both the forward-selection and backward-elimination stages of greedy algorithms in general.

This work was done by Baback Moghaddam of Caltech for NASA's Jet Propulsion Laboratory.

The software used in this innovation is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-45333.

Modeling Common-Sense Decisions in Artificial Intelligence

Common sense is implemented partly by feedback from mental to motor dynamics.

NASA's Jet Propulsion Laboratory, Pasadena, California

A methodology has been conceived for efficient synthesis of dynamical models that simulate common-sense decision-making processes. This methodology is intended to contribute to the design of artificial-intelligence systems that could imitate human common-sense decision making or assist humans in making correct decisions in unanticipated circumstances. This methodology is a product of continuing research on mathematical models of the behaviors of single- and multi-agent systems known in biology, economics, and sociology, ranging from a single-cell organism at one extreme to the whole of human society at the other extreme. Earlier results of this research were reported in several prior *NASA Tech Briefs* articles, the three most recent and relevant being "Characteristics of Dynamics of Intelligent Systems" (NPO-21037), *NASA Tech Briefs*, Vol. 26, No. 12 (December 2002), page 48; "Self-Supervised Dynamical Systems" (NPO-30634), *NASA Tech Briefs*, Vol. 27, No. 3 (March 2003), page 72; and "Complexity for Survival of Living Systems" (NPO-43302), *NASA Tech Briefs*, Vol. 33, No. 7 (July 2009), page 62.

The methodology involves the concepts reported previously, albeit viewed from a different perspective. One of the main underlying ideas is to extend the application of physical first principles to the behaviors of living systems. Models of motor dynamics are used to simulate the observable behaviors of systems or objects of interest, and models of mental dynamics are used to represent the evolution of the corresponding knowledge bases. For a given system, the knowledge base is modeled in the form of probability distributions and the mental dynamics is represented by models of the evolution of the probability densities or, equivalently, models of flows of information.

Autonomy is imparted to the decision-making process by feedback from mental to motor dynamics. This feedback replaces unavailable external information by information stored in the internal knowledge base. Representation of the dynamical models in a parameterized form reduces the task of common-sense-based decision making to a solution of the following hetero-associated-memory problem: store a set of m predetermined stochastic processes given by their probability distributions in such a way that when presented with an unexpected change in the form of an input out of the set of M inputs, the coupled motor-mental dynamics converges to the corresponding one of the m pre-assigned stochastic process, and a sample of this process represents the decision.

This work was done by Michail Zak of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-44114