Progress on two projects:
Electromagnetic probes of biological molecular motors
Low-frequency dielectric spectroscopy of Martian soil samples

John H. Miller, Jr.

SUMMARY

The aims of these projects are: 1) to study the electromagnetic properties of active enzyme complexes in live organisms, and 2) to investigate Martian soil simulants and live cell suspensions using low-frequency dielectric spectroscopy and related techniques. Our studies have focused on both linear (dielectric) and nonlinear (harmonic) responses, and include studies of whole cells, extracted organelles such as mitochondria and chloroplasts, and whole organisms. Continuance of these studies has been aided by a post-doctoral aerospace fellowship (PDAF) awarded to David Warmflash, M.D., and the results are discussed in a companion report, "Martian Soil Biosensors Based on Dielectric Spectroscopy." New resulting publications and presentations have benefited from both the previous mini-grant as well as the ongoing PDAF program, and are listed in the companion PDAF report. (See page 61 for full report.)

John H. Miller, Jr.

Computational methods in non-smooth mechanics: Application to dry friction constrained motions

LieJune Shiau

ABSTRACT—NASA researchers need more sophisticated friction models and computational techniques. New models offer a better description of system behavior when velocities are close to zero. With improved numerical computational techniques, science can better solve higher-dimensional problems.

SUMMARY

We studied the time-discretization of those relations modeling some elasto-dynamical systems with friction. The main goal of this project is to address similar problems using more sophisticated friction models and novel computational techniques. The new models give a better description of the system behavior when the velocities are close to zero. These investigations are motivated by the need for more accurate friction models in the software simulating the motion of mechanical systems, such as the remote manipulators of the Space Shuttle or of the International Space Station.

LieJune Shiau

RESULTS

We first studied several models of the constrained motion under consideration, including a rigorous formulation involving a kind of dynamical multiplier. Next, in order to treat friction, we introduced an implicit-explicit numerical scheme that is unconditionally stable and easy to implement. Finally, the above scheme was coupled, via operator-splitting, to schemes classically used to solve differential equations from frictionless elasto-dynamics. The above schemes were validated through a series of numerical experiments.

FUNDING AND PROPOSALS

Shiau, L. Friction constrained model, Texas Higher Education, ARP, $71,325 (2006–2008) (*submitted*).