PURDUE UNIVERSITY Discovery Park

Discovery Park Impact

NNSA PRISM Center for Prediction of Reliability, Integrity and Survivability of Microsystems

NEED

During the last few years, civilian and defense sectors have invested heavily in the development of micro-electro-mechanical systems (MEMS) for sensing, communications and other critical applications. MEMS combine electronic and mechanical components on a microscopic scale. Switches are needed to turn radio signals on and off for a variety of purposes, including the deployment and activation of weapons and routing satellite communications. However, MEMS have not thus far been able to meet stringent performance and reliability requirements. Reasons for unexpected failures are poorly understood.

INITIATIVE

The Prediction of Reliability, Integrity and Survivability of Microsystems (PRISM) Center was launched on April 15, 2008. The University of Illinois, Urbana-Champaign, and University of New Mexico will collaborate in PRISM. Purdue is one of 5 centers funded under NNSA's Predictive Science Academic Alliance Program (PSAAP); the other four are at California Institute of Technology, University of Michigan, Stanford University, and University of Texas at Austin. PRISM will be based at the Birck Nanotechnology Center and is affiliated with the Birck and Energy Centers, both in Purdue's Discovery Park.

IMPACTS

About 35 researchers at Purdue, including faculty members, software professionals and students, will help perfect miniature switching devices for weapons systems and commercial applications by developing verified and validated advanced simulations needed to predict the reliability and durability of MEMS. A key aspect will be quantifying the uncertainties of both the validation data and the simulation and the impact of these on the accuracy of the reliability predictions. Dr. Jayathi Y. Murthy, professor of Mechanical Engineering, directs the new center.

Dr. Jayathi Y. Murthy

"The center takes advantage of Purdue's interdisciplinary strengths and considerable expertise in computational modeling and nanotechnology," said Purdue President France A. Córdova. The devices are being created to replace conventional switches and other electronic components critical for radio communications and weapons deployment. MEMS are far lighter and smaller than conventional technology and could be manufactured in large quantities at low cost.

The new simulations will make it possible to accurately predict how well the MEMS devices would stand up to the rigors of battle and how long they would last in the field. Devices in missiles and other weapons must withstand crushing gravitational forces, temperature extremes and shocks from impact. In order for the predictions to contribute to decisions to deploy MEMS devices, the simulations themselves must be "reliable". Making such a determination requires that the simulations be verified and validated and that any uncertainties be quantified. Only then can the simulation be used to predict the reliability of a device with a quantifiable degree of certainty.

The research will draw on expertise and facilities affiliated with Purdue's Network for Computational Nanotechnology, based at the Birck Nanotechnology Center, and the Rosen Center for Advanced Computing, a division of Information Technology at Purdue. The NNSA national laboratories will be involved as unfunded collaborators and advisors in the research.

Funding for PRISM

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