Interdisciplinary Research Program

Computational Tools for the Atomic/Continuum Interface: Nanometer to Millimeter Scale Aircraft

Prospective Graduate Students and Postdoctoral Fellows from engineering, physics and mathematics with outstanding records are encouraged to apply for a highly interdisciplinary basic research program on the forefront of science and engineering. The research concerns the development of new concepts for flight at nanometer to millimeter scale, with applications to atmospheric flight and to the design of vehicles for microsurgery. The general framework for this research is the propulsion of small vehicles by the motion of active materials - ferroelectric, magnetostrictive and shape memory materials - configured as deformable tubes, flaps or flagella and powered by a remotely applied electromagnetic field. The research is based in scientific computation, with additional opportunities in mathematical modeling and laboratory research. Specific research areas include:

1. Fluid mechanics and aerodynamics at nanometer to millimeter scale
2. Phase transformations and the behavior of active materials at small scales
3. Computational methods for the passage from atomic to continuum scales
4. The synthesis of active materials by molecular beam epitaxy
5. The design of micro-electro-mechanical (MEMS) systems for small scale flight

The participants with a brief summary of their fields are listed below. Interested persons are encouraged to contact any of the participants by e-mail for further information and application materials. For general information on the project, contact R. D. James, james@aem.umn.edu.

Kaushik Bhattacharya, Applied Mechanics, California Institute of Technology. Shape memory materials, active thin films, continuum mechanics of materials. bhatta@cco.caltech.edu

Iain D. Boyd, Mechanical and Aerospace Engineering, Cornell University. Computational fluid dynamics at the atomic continuum interface, Monte Carlo methods. boyd@mae.cornell.edu

Graham V. Candler, Aerospace Engineering and Mechanics, University of Minnesota. Computational fluid dynamics at the continuum/atomic interface aerodynamics. candler@aem.umn.edu

Richard D. James, Aerospace Engineering and Mechanics, University of Minnesota. Shape memory and magnetostrictive materials, active thin films, mathematical methods for change-of-scale. james@aem.umn.edu

Mitchell Luskin, School of Mathematics, University of Minnesota. Computational materials science, microstructure, phase transformations. luskin@math.umn.edu

Chris J. Palmstrom, Chemical Engineering and Materials Science, University of Minnesota. MBE of thin films of microelectronic, magnetic and active materials. palms001@gold.tc.umn.edu

Karin M. Rabe, Applied Physics and Physics, Yale University. Density Functional Theory predictions of atomic level structural properties of active materials, effective Hamiltonians for ferroelectrics and related materials. rabe@critical.eng.yale.edu

Facilities for the research include a dedicated multiprocessor machine for simulation, advanced molecular beam epitaxial system for the growth of thin films, clean room facilities for the analysis and patterning of thin films.

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