ENGINEERING MECHANICS AND MATERIALS RESEARCH
IN THE INFORMATION TECHNOLOGY AGE *

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Abstract: In this paper, importance of information technology research and development for economic growth and prosperity is presented. Major mission of the research for fundamental science and engineering base is discussed. Critical points of the mechanics and materials research in the 21st Century are proposed.

Key words: engineering mechanics; materials; information technology; NSF

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Introduction

The National Science Foundation (NSF) has supported basic research in engineering and the sciences in the United States for a half century and it is expected to continue this mandate through the next century. As a consequence the United States is likely to continue to dominate vital markets because diligent funding of basic research does confer a preferential economic advantage (Wong, 1996)[1]. Concurrently over this past half century, technologies have been the major drivers of the economy, and as well, NSF has been a major supporter of these technological developments. According to the NSF Assistant for Engineering, Eugene Wong, there are three transcendental technologies (Wong, 1999)[2]:

- Microelectronics — Moore’s Law: doubling the capabilities every two years for the last 30 years; unlimited scalability; nanotechnology is essential to continue the miniaturization process.
- Information Technology — NSF and DARPA started the Internet revolution about three decades ago; confluence of computing and communications.
- Biotechnology — molecular secrets of life with advanced computational tools as well as advances in biological engineering, biology, chemistry, physics including mechanics and materials.

By promoting research and development at critical points where these technological areas intersect, NSF can foster major developments in engineering. The solid mechanics and materials engineering (M&M) communities will be well served if some specific linkages or alignments are made toward these technologies. Some thoughtful examples for the M&M communities are:

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Considerable NSF resources and funding will be available to support basic research related to these technologies. These opportunities will be available for the individual investigator, teams, small groups and larger interdisciplinary groups of investigators. However, most of the funding at NSF will continue to support unsolicited individual investigator proposals on innovative “blue sky” ideas.

In addition to NSF, there is also a sense that U. S. Federal agency research support is increasingly being driven by broad systematic initiatives. One of these initiatives is Information Technology (IT), listed above as one of the transcendental technologies. The President’s Information Technology Advisory Committee (PITAC) advises that an “immediate and vigorous information technology research and development (R&D) effort in Information Technology be initiated. IT is essential for the United States to have economic growth and prosperity in the 21st Century.” PITAC (www.ccic.gov) concluded that current U. S. Federal support for research in IT is inadequate and these current efforts also take “a short-term focus for immediate returns.” PITAC recommends IT R&D with long term priorities focusing on “software development that is far more usable, reliable, and powerful, scalable information infrastructures that satisfy the demands of large numbers of users, high-end computing systems with both rapid calculation and rapid data movement, and IT education and training for the citizenry.” Achieving these ends requires diversified modes of research support to foster projects of broader scope, longer duration and emphasis on projects involving multiple investigators over several years. Of most importance is using these new information technologies to advance critical application domains for the benefit our nation.

1 Discussion

Consistent with this theme, the National Science Foundation Directorate for Engineering in collaboration with other NSF Directorates and Federal agencies recently announced several IT-related initiatives. The NSF Directorate for Computer and Information Science and Engineering (CISE) and the Directorate for Engineering in cooperation with Division of International Programs jointly announced the Wireless Information Technology and Networks initiative (Program Announcement NSF 99-68) in early 1999. “The great demand for Internet services, wireless cable television distribution, and information technology, makes the development of broadband wireless mobile communication systems a national imperative in the 21st Century.” Researchers face many technical challenges, but “data rates of tens of megabits per second (enabling broadband Internet access, for example) are apparently realizable in the near future.”

The Engineering Directorate research initiative on Engineering Microsystems: “XYZ on a Chip” (Program Announcement NSF 99-31) focuses on non-electronic applications of microelectronic technologies and exploration of non-electrical processes at the micro-scale. Here XYZ refers to any non-electrical phenomena such as “biology, genomics, chemistry, optics,