

# Strategic Plan for the Mechanical Properties Research Laboratory (MPRL)

Submitted by

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## Vision

The MPRL shall be known as a world class university laboratory featuring deformation, fracture and fatigue research of various structural materials, with a unique combination of experiment and modeling through the effective union of the disciplines of experimental mechanics, solid mechanics, materials science, and materials engineering.

## Mission

The mission of the MPRL is to:

- conduct nationally leading research with emphasis on structural applications
- significantly enhance interdisciplinary graduate education
- disseminate valuable information through research, publication and presentation
- carry out a service role as a technical resource for industry/government

The fundamental long term goal of the MPRL is to carry out its teaching, research, and service functions at a level commensurate with the leading university laboratories in the world involved in mechanical properties research, and to be so recognized.

## Situational Analysis

The Mechanical Properties Research Laboratory (MPRL) is an interdisciplinary laboratory with principal activities directed towards the measurement and understanding of the mechanical properties of engineering materials. The MPRL impacts very directly on research and education programs within the academic units of the College of Engineering, principally ME and MSE, with 100% of its funding directed towards these activities. In its role as an interdisciplinary umbrella organization for experimental research in mechanical properties of materials, the MPRL provides a degree of coordination of equipment usage, training and maintenance that would otherwise be much more costly to the sum of academic units in the conventional university setting of single investigator-controlled equipment. Principal activities of the MPRL include:

- Fatigue and fracture studies of structural materials, structures and joints
- Characterization and quantitative analysis of microstructure and damage in engineering materials
- The study of durability and degradation of aging materials and structures
- Development of constitutive equations for deformation and damage of engineering materials, including life prediction methodologies
- Development of improved constitutive models and simulation capability for materials processing

Participation for FY 00-01 included:

- Faculty and students from ME, MSE and interactions with AE, CEE, T&FE, and, GTRI

Technical staff for FY 00-01 included:

- Research Equipment Specialist (Rick Brown)
- Technician (Robert Cooper)

## **External Factors**

### Opportunities

- The subject of “materials” is identified on many government, industry and university planning documents as a strategic research area
- The demand remains high for graduates with a background in experimental characterization of mechanical properties, mechanics modeling of materials, and failure analysis
- There is an increasing emphasis on life extension of infrastructure (transportation, military, etc.)
- The shift of U.S. industry away from in-house R&D and towards outsourcing continues
- An international emphasis on telecommunications and electronics inevitably requires new, mechanically uncertain materials and material systems be employed in affordable consumer electronics
- The relatively recent and strongly emerging interest in designing materials requires more complex, multiple length and time scale experiments, including mechanical testing and high resolution characterization, as well as computational micromechanics; the MPRL is positioned well among U.S. universities to satisfy this combination of requirements
- There is a high demand for multidisciplinary and multi-university teaming arrangements from funding agencies; MPRL faculty and programs are well-positioned for these kinds of programs.

### Challenges

- Intensification of competition for government and industry resources; need for teaming arrangements
- Increasing competition for high quality graduate students, along with decreasing pool of applicants, given the state of the U.S. economy over the past 12 months

## **Internal Status of Research within the MPRL**

### Strengths

- High quality, internationally recognized faculty
- Attracts high quality graduate students and actively involves undergraduate students
- Annual industry and government support of \$2-3M
- Graduate certificate program in Mechanical Properties of Solids
- Connections with industry and national laboratories
- Faculty and facilities are easily mobilized to facilitate teaming

### Weaknesses

- Continuing need for special allocations for unexpected emergency maintenance and repair given lack of basic maintenance contracts for equipment

## **Objectives**

- Continue to develop a leading position in mechanical properties research; maintain and enhance \$3M+

- annualized sponsored research funding level, including block funding
- Maintain high level of M.S. and PhD production, with special attention on quality and placement of graduate students

### **Strategies, Action Plans, and Assessment Procedure for Reaching Objectives**

#### **Development of a Leading Position in Mechanical Properties Research**

##### **Action Plan**

- Identify key research opportunities and pursue, particularly teaming arrangements through collaboration with CERC, Materials Council, etc. Continue to aggressively respond to NSF, DoD, DoE, DARPA and NASA block funding initiatives
- Support increased faculty/facilities participation and productivity by more substantial support of lab technician
- Support increasing emphasis on combined computation and experiment
- Further improve the quality of incoming graduate students, as well as placing graduating students in academic and research positions at prestigious universities and laboratories

##### **Performance Assessment**

The annual activity report from the MPRL Director and Associate Director will include:

- Listing of faculty participants
- Summary information regarding funded projects, papers published
- Involvement of M.S. and Ph.D. Students
- Certificates awarded
- Faculty and student recognition

A Faculty Governance Board consisting of active MPRL faculty will continue to meet periodically, as the need arises, to discuss MPRL programs and opportunities. Feedback is also obtained in the fall of each year from the External Advisory Board of the School of Materials Science and Engineering rather than constituting a separate Board.

#### **Increased Graduate Degree Productivity**

##### **Action Plan**

- Vigorously pursue block funding opportunities and program development

##### **Performance Assessment**

As mentioned in a previous section, we have been very aggressive in developing and responding to block funding initiatives over the past five years. We have enjoyed increasing numbers of high quality graduate students working within the MPRL, due to the recruitment efforts of individual faculty and the high priority on graduate recruiting of involved Schools. Several students from DoD programs have opted to conduct their graduate research within the MPRL.

The action plan for increasing research funding and graduate degree productivity will be implemented and monitored annually by the MPRL Director.

#### **Enhancement of Service and Economic Development**

### **Action Plan**

- Play an active role in professional society and journal editing leadership
- Use video/satellite technology for short courses and/or topical lectures
- Pursue development of leading textbooks and monographs

### **Performance Assessment**

The action plan for implementing an enhanced service function will be monitored by the Director.

MPRL faculty presently hold key roles in professional societies and related journals which deal with mechanical properties research. This is a most effective vehicle to publicize MPRL activities.

MPRL faculty offer a very attractive, extensive set of graduate courses in fracture mechanics which will serve as a basis for future short course, video and internet offerings.

### Developing a Diverse Student Body and Faculty

#### **Action Plan**

- Work with participating faculty/Schools to ensure participation of a broad, diverse pool of students and faculty members.

#### **Performance Assessment**

The action plan will be monitored by the Director in cooperation with participating MPRL faculty, and graduate coordinators in the College of Engineering.