

**School of Engineering and Technology, IUPUI
Multidisciplinary Undergraduate Research Institute (MURI)**

MURI Mentors Project Application Form

For Fall 2005

- *To be completed by a Faculty or Research Staff Member from the School of Engineering and Technology.*
- *To fill in this form place your cursor in the form field and type. Tab from field to field.*

Date: July 2005

Name of Proposer: Jie Chen

Title of Proposer: Professor

Department of Proposer: Mechanical Engineering

Proposed Project Title: A study of effect of mechanical stimulation on bone cells in mice

Approximate Duration: One semester

Number of Students Requested: 2

Disciplines or Majors Involved (at least two disciplines): ECE and ME

Support Needed from MURI for Supplies and Equipment Usage (\$2,000 limit per team):
\$2,000

Project proposal with sections for the following information (please attach or cut and paste into this form):

1) Objectives, 2) Research Methodology, 3) Team Organization, 4) Expected Outcomes, 5) Benefits, 6) Time-Table, 7) Justification of Budget for Equipment and Supplies, 7) Short Resume. No more than five pages, excluding resume.

Title: A study of effect of mechanical stimulation on bone cells in mice

Project Proposal

Objective:

Bone tissue is sensitive to its mechanical environment. Mechanical loading probably is one of the most anabolic stimuli available for bone. Our previous studies have shown that

a single three-minute session of loading can increase bone formation rate 4- to 6- fold. No other anabolic agent, hormone or biochemical, can cause such a large increase in bone formation after a single dose. The control of bone response to loading occurs at both a tissue and cellular level. The processes of mechanotransduction can be divided into four distinct phases: 1) mechanocoupling, 2) biochemical coupling, 3) transmission of signal and 4) effector cell response to form or resorb bone matrix. However, the mechanisms involved in mechanotransduction are not well elucidated. In this project, we will build a cell fluid flow system to apply shear stress on osteoblastic cell and an in vivo loading system to apply force on mouse's ulna. Using these 2 models, we can study the mechanisms involved in mechanotransduction at both cell and animal levels.

Research Methodology:

Setup of a Force-Control In vivo Loading System to Effect of Loading on Bone

Task: To build an in vivo loading system.

We already have computer, the controller and the shaker. We hope the system will be a force control dynamic loading system (Figure 1). We need to build the apparatus, including load cell, which can be used to hold mouse ulna and apply force on the ulna.

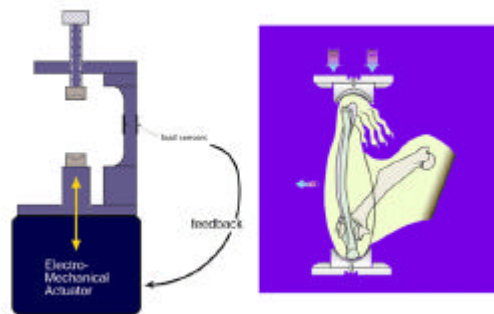


Fig.1. The figure shows the setup of a mouse ulna loading device.

Team Organization

Two students, one with Electrical and Computer Engineering and one with Mechanical Engineering background are needed.

Two faculty members will supervise the project

Jie Chen, Ph.D.

Professor

Department of Mechanical Engineering

Purdue School of Engineering and Technology, IUPUI

Jiliang Li, Ph.D. & M.D.
Assistant Research Professor
Department of Anatomy and Cell Biology
Indiana University School of Medicine

Responsibilities

The students are responsible for establishing the needs, creating engineering specifications, developing concepts, and making a prototype. The ME student will focus on mechanical aspect of the project, which includes loading, supporting, and fixture design. The ECE student will focus on electrical aspect, which includes sensor, control, and circuit design. Students will also need to produce a final report as well as an oral presentation.

Faculty members will be supervising the project, providing guidance, and evaluate the project.

Expected Outcomes

We expect the loading system can apply mechanical stimulations in various waveforms with a variety of frequencies and amplitudes.

Benefits

The device designed will benefit the bone research activities in IU medical center. Students will gain knowledge on objectives driven research, learn design process, and have experience on biomedical research that is multi-disciplinary.

Time-Table

One semester

Budget Justification

In addition to stipends for the two students, we requests \$2,000 from MURI to cover the cost for material, transducer, and machining. The total cost was estimated around \$7,000. The rest of the cost will be paid from research grant.

Brief CV

CURRICULUM VITAE (brief)

JIE CHEN

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Indiana University Purdue University Indianapolis
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EDUCATION: Ph.D., Mechanical Engineering, Drexel University, Philadelphia, 1989.
M.S., Biomedical Engineering, Shanghai Second Medical College, China, 1984.
B.S., Mechanical Engineering and Mechanics, Tianjin University, China, 1982.

PROFESSIONAL EXPERIENCE:

2000 - Present INDIANA UNIVERSITY PURDUE UNIVERSITY AT INDIANAPOLIS
Professor of Mechanical Engineering
Adjunct Professor of Orthodontics

2000 - 2001 FORD MOTOR COMPANY
Senior CAD/CAE/CAM/PIM Training Specialist

1997-1999 INDIANA UNIVERSITY PURDUE UNIVERSITY AT INDIANAPOLIS
Acting Chair of the Dept. of Mechanical Engineering

1995-2000 INDIANA UNIVERSITY PURDUE UNIVERSITY AT INDIANAPOLIS
Associate Professor of Mechanical Engineering
Adjunct Associate Professor of Orthodontics

1990-1995 INDIANA UNIVERSITY PURDUE UNIVERSITY AT INDIANAPOLIS
Assistant Professor of Mechanical Engineering
Adjunct Assistant Professor of Orthodontics

1989-1990 DREXEL UNIVERSITY
Research Postdoctoral Fellow
Instructor Postdoctoral Fellow

PUBLICATIONS: Dr. Chen has published 78 refereed journal and conference papers. Some of the recent publications are listed

1. Zhang, D., Chen, J., Hsieh, T., Rancourt, J., and Schmidt, M.R., "Dynamic modeling and simulation of one- and three- mode electric variable transmission" International Journal of Vehicle Design, Vol. 35, Issue 3, 241-273, 2004
2. Cao, M. and Chen, J. "HEV Maximum Power Performance Simulation and Duty Cycle Generation" International Journal of Vehicle Design, 2004, (in press)
3. Chen, J., and El-Mounayri, Advanced Manufacturing – a crucial technology for the competitiveness of a company in 21st Century, INTMA Tooling and Machining Magazine, 2004
4. Katona, TR, Le, Y, and Chen, J., "The effects of first- and second-order gable bends on forces and moments generated by triangular loops", American Journal of Orthodontics and Dentofacial Orthopedics, accepted 2004.
5. Chen, J., Bai, G., Shen, Z., Li, X., Fulton, D., Hsu, A. "Prediction of Failure Rate of Rotary Machine Using Computer simulations," Accepted by the ASME Journal of Manufacturing Science and Engineering, 2004

EXTERNAL AND INTERNAL FUNDING:

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Please submit applications to MURI Scholars Program, Kelly Koher at kkoher@iupui.edu or 723. W. Michigan St., Rm. SL 260, Indianapolis, Indiana 46202, Tel: 317-274-9717, Fax: 317-274-9744. Electronic submissions are preferred.