

**FACULTY SCHOLARSHIP GRANT
2007-08 APPLICATION**

The Faculty Scholarship Grant provides supplementary support to encourage faculty to engage in *scholarly research, learning, and creative activities* to enhance personal professional development. The Grant is a stand-alone program and not intended to supplement or replace departmental general funds or other existing funding programs (e.g., start-up, grants and contract cost-shares, C2E2, student support, etc.). Academic faculty, tenured or on tenure track, may apply.

The Faculty Scholarship Grant Committee will seriously consider proposals to cover faculty expenses in the following categories:

1. Seed money to initiate a new scholarly or creative activity (junior faculty are especially encouraged to apply)
2. Projects for writing books and research articles (note, however, that funds for activities like archival data collection, site visits, interviews, and manuscript preparation will have priority over editorial assistance and indexing, and that scholarly monographs will have priority over textbook projects and articles)
3. Travel support for *educational* workshops and training programs related to the scholarly interests of the proposing faculty
4. Art performances and exhibits
5. Other activities contributing to personal scholarly research and development

The Faculty Scholarship Committee will ordinarily **NOT** approve proposals in the following categories:

1. Travel to professional conferences/meetings
2. Improvements in classroom instruction (this area is covered by the Faculty *Development* Grant program)
3. Organization of symposia
4. Salary supplement or per diem
5. Teaching Assistant support
6. Additions to personal professional libraries, computer or equipment purchases, and similar things

The basic intent of the Faculty Scholarship Grant is to provide some balance in faculty support for those areas of creative endeavors that are not necessarily task- or mission-specific or directly linked to external research fundraising, such as the Research Excellence Fund program. Applications for the Grant should clearly indicate the specific end products expected from the proposed projects and how they will contribute to the applicant's scholarly development.

Proposals will be reviewed by the Faculty Scholarship Grant Committee, which will then advise the Vice President for Research. Grants are normally \$5,000 or less. The Committee will consider proposals exceeding that amount only under very special circumstances. Proposed budgets should be clear and detailed.

When a Faculty Scholarship Grant proposal is approved, a University account will be established with the faculty as account manager. Disbursement of the grant money will be subject to the usual rules and regulations that apply to University accounts. The Grant may not be used to reimburse departmental funds if release time is provided to support related activities.

Successful applicants must submit a final report summarizing their accomplishment at the end of the project. Failure to do so will make a faculty member ineligible for future grants.

Date _____ Dept/School: _____

Name _____ Email _____

Academic Rank: _____

Title of Proposed Project: _____

Time Period of Proposed Project _____ Funding Support Requested _____

**Submit the original and eight (8) copies of your application to 317 Admin Bldg
no later than 4 pm on November 15, 2007.**

Project Statement

Quieter Technologies for Environmental Noise Pollution Control

By

Professor Mohan D. Rao, Michigan Technological University

Summary

The proposed project activity will include two components: a) teaching of a short course on environmental noise control and at the Indian Institute of Science (IISc), India during the summer of 2008 and b) lecturing in a 3-day workshop on the development of quieter technologies for reducing environmental noise pollution with particular emphasis on automotive noise. The proposed special 8-week course is planned to be offered by the author on the campus of IISc, Bangalore, India, during June-August 2008. Particular emphasis will be on emerging topics in the area of automotive noise and vibrations, including diagnostics, vibro-acoustics modeling and prediction, sound perception and quality of next generation alternate fuel and hybrid vehicles. The impact of these emerging and other new technologies, illustrated through case studies and extensive professional experience of the author will be an important aspect of this course. In addition to the proposed course, the author will also engage in other scholarly activities at IISc, including participation in a 3-day workshop on "Development of Quieter Technologies," the details of which are being planned by the host organization. A follow-up plan to co-author a monograph based on the course material has also been formulated. The proposed project activity will benefit MTU in providing international leadership role, prestige, and will expose the emerging technologies in product noise control to new customers such as the automotive industry that is growing in India. Funds are requested from the Faculty Scholarship Grant Program to cover travel and other expenses related to the project. The host institution will cover local hospitality and lodging.

Intellectual Merit and Broader Impact

The proposed course is based on the author's extensive academic experience and interactions with industry over the past two decades. It will expose the participants to cutting-edge research and stimulate collaborations to address noise and vibration problems faced by industry and society. Issues like noise pollution are drawing more attention as the sound levels in many Indian cities have been increasing on a continual basis. The fundamental change in this regard can be accomplished by designing quieter equipment and transport vehicles, which will yield global benefits.

The planned workshop on quieter technologies is designed to have a broad impact in the areas of diagnostic and identification techniques; active control and smart structures; and new or improved techniques to solve complex problems involving acoustics, vibrations, non-linear dynamics and chaos both for research and education. New research issues must be defined within the context of the Indian and other emerging economies and industry. Further, it is desirable to establish a long-term partnership on the international level to further address common national interests and priorities in the area of noise and vibration control to form a focused direction on several important scientific issues pertinent to many countries.

Need for Environmental Noise Control

Environmental noise pollution is increasing at an alarming rate all through the globe, and especially in developing countries such as India because of industrialization and urbanization. The main sources of noise include noise from various industries and large machines operating at very high speeds and high loads.

Non- industrial source of noise includes the noise created by road, air and train traffic and the neighborhood noise generated by various construction industries, consumer products, and noise in buildings.

The effects of exposure to high dosage of noise are both health and behavioral in nature. Sound is a particular auditory impression perceived by the sense of hearing. The presence of unwanted sound is noise pollution. These unwanted sounds can seriously damage and affect physiological and psychological health. For instance, noise pollution can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, and other harmful effects depending on the level of sound.

Noise-induced hearing loss is one of the most common occupational illnesses in the world. Occupational hearing loss is a permanent illness, with no recovery currently possible. Hearing loss severely impairs the quality of life, and in its most severe degree, presents a handicap that prevents the worker from being able to communicate effectively at work and at home. A 1995 National Institute of Occupational Safety and Health (NIOSH) health hazard evaluation (HHE) study revealed that up to 50% of the 7.3 million construction workers in the US exhibit a hearing disability by age 50. Carpenters aged 25–35 years have the hearing equivalent of a 55-year-old worker who has not been exposed to excessive noise. The National Academies of Engineering (NAE), “Workshop on Technology for a Quieter America” held in Washington DC, Sept. 13-15, 2005 summarizes that the supply of noise control professionals coming out of universities is inadequate to meet anticipated future demand. The summary further states, “a program for research and development support will encourage technology development through the efforts of private research and development organizations, research institutes, universities, and government laboratories” and “that current human and physical infrastructure is inadequate for noise control research and application efforts.”

The discipline of noise engineering can therefore be viewed as truly interdisciplinary since it includes the elements of many branches of engineering and the physical sciences. The need for quieter, reliable and safer products, machines and equipment is well recognized to reduce noise-induced hearing loss as well as improve human comfort and quality of life. Currently, industry has been focusing on two objectives: (1) to meet environmental/health and safety regulations and standards, and (2) to design high-quality, durable, competitive and customer-friendly products. The technical issues when meeting these objectives impact the industrial competitiveness and global trade considerations for all companies involved. Much education and research is needed to address the technological and societal issues faced by modern vibration and noise engineers and practitioners.

Course Learning Objectives

This course addresses the analysis and solution of practical environmental noise problems. Fundamental concepts of sound generation and propagation, the unwanted effects of noise, assessment of sound quality, and source-path-receiver concepts in noise control will be taught. Lecture, measurement laboratory, and team project directed at solving a real noise problem under a client's sponsorship are salient features of the course.

Identifying major noise sources in a product is crucial for developing quieter technologies and high impact noise control designs. While understanding the mechanism of a noise source, it is important to identify sources of inefficiency in the product and identify the inefficiencies that are related to the identified noise sources. Often the most significant noise sources also have a significant impact on performance. For example, this may include an inefficient cooling air flow design path through a certain tool causing both inefficient heat removal and turbulent flow induced noise emission. Once the mechanism of the noise sources are understood, along with the resulting poor performance of the tool, the noise control solution can be developed to focus on the primary noise sources while also improving tool performance.

Workshop Objectives

A 3-day workshop on “Quieter Technologies” is being planned to be organized at the campus of IISc during the second week of August 2008. Professor Munjal of IISc is the main organizer of the workshop; he will be assisted by the author in the development, organization and lecturing efforts. Particular emphasis will be on recent trends and developments in the area of automotive Noise, Vibration and Harshness (NVH) of next generation alternate fuel and hybrid vehicles. It is anticipated that the proposed workshop will a) aid the Indian automotive companies in the design and development of quiet cars; b) contribute to the education and training of PhD students and engineers in NVH who are currently in need; and c) foster increased interactions and collaborations with industry and other academic institutes.

Post-visit Follow-up and Plans for New Collaborations

Based on the course and workshop material, Professor Munjal and Professor Rao expect to write a monograph on environmental noise and engineering control to be published within a year after the proposed activity. We also expect to formulate and initiate a plan to conduct collaborative work in automotive research and development. In addition, we expect to identify critical infrastructure needs for conducting experimental work in Indian Universities, and design and develop a plan that can be used to secure funding from the State, Federal and industrial sources.

Qualifications and Previous Experience of Professor Mohan D. Rao

M. D. Rao is a professor of Mechanical Engineering at Michigan Technological University. He has over twenty years of teaching, curriculum development and research experience in different areas of noise and vibration with particular applications to automotive, aerospace, construction equipment, and snowmobile and appliance industries. He has been a PI or Co-PI for several research projects with a budget of about two million dollars. His research has been sponsored by NASA, NSF, ARL, Ford, GM, Daimler-Chrysler, Caterpillar, TRW, Johnson Controls, John Deere, NIOSH, ArcticCat, Polaris, Volvo-Korea, Daewoo-Korea and other industries. He has advised 5 Ph.D.s and 25 M.S. students and currently advising 3 Ph.D. and 5 M.S. students. He has published over 100 technical papers in various journals and conference proceedings. Additionally, he worked at Ford Motor Company in their acoustics division for one year during 1996-97 as part of his sabbatical leave. He has also been working at the U.S. Army Research Laboratory for the past five summer terms in their Auditory Research Department on various projects related to the design and development of hearing protectors and headgear for soldier systems.

Budget:

1. Travel (Air fare): \$2500 (Lodging and local hospitality will be provided by the host institution)
2. Supplies(Noise Control Demo Kits):\$1500
3. Misc. Services: \$500

Total Requested \$4500.00

Attachment: Invitation from Prof. M.L. Munjal of Indian Institute of Science

Curriculum Vitae

Mohan D. Rao, Ph.D.

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Web Page: (<http://www.me.mtu.edu/~mrao>)

Summary of Professional Accomplishments:

- Fellow of the American Society of Mechanical Engineering (ASME).
- Fellow of the Society of Automotive Engineering (SAE).
- Over twenty years of experience in different areas of noise control, acoustics, vibration, and dynamics with particular applications to automotive, snowmobile, aerospace, construction equipment, and appliance industries.
- Managed over 2 million dollars of sponsored research from NSF, ARL, Ford, GM, Daimler-Chrysler, Caterpillar, TRW, Johnson Controls, John Deere, Whirlpool, NIOSH, LMS North America, and Volvo-Korea.
- Mentored 5 Ph.Ds and 25 M.S. students; currently advising 3 Ph.D. and 5 M.S. students.
- Widely traveled within USA and abroad to teach continuing education courses to Ford, Visteon, TRW, Kysor, Xerox, Daewoo-Korea, LMS-Belgium, Yanmar Diesel-Japan, and Universities in Korea.
- Published over 100 technical papers in various journals, and conference proceedings.
- Selected as a United Nations Developing Nations Program (UN-DP) expert on Vibration Damping.
- Received the National Science Foundation Research Initiation Award.
- Honored by the NASA Marshall Space Flight Center for work on the damping of the Hubble Space Telescope truss system.

Education

1988	Ph.D., Mechanical Engineering, Auburn University, Auburn, AL.
1983	M.S., Mechanical Engineering, Indian Institute of Science, India.
1981	B.S., Mechanical Engineering, Bangalore University, Bangalore, India.

EXPERIENCE -ACADEMIC

Professor (2007-present); Associate Professor (1994-2007); Assistant Professor (1988-1994)

Mechanical Engineering-Engineering Mechanics Department, Michigan Technological University.

- Responsibilities include teaching, course and curriculum development, graduate student advising, externally funded research, scholarship and professional service.

1984 – 1988 Graduate Research Assistant, Department of Mech. Engg., Auburn University.

Experience -Industrial

August 2001 Summer Faculty Fellow, Boeing Commercial Airplanes Group, Seattle, Washington.

- Worked in the area of skin damping for aircraft structures, and Statistical Energy Analysis (SEA) for the prediction of acoustic transmission loss of fuselage panels.

1996 – 1997 Research Engineer, Ford Motor Company, Dearborn, MI (on sabbatical from MTU)

- Worked in the area of chassis systems noise & vibrations. Developed new test-based models for characterizing the dynamic properties of bushings & shock absorbers for noise and vibration control.

Experience -Government Lab

Summer Faculty Fellow: June-August 2006, 2005, 2004, 2003, 2002.

Human Research and Engineering Directorate, U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD.

- Worked with the Auditory Research Group on the development and implementation of new speech tests for army communication systems. Auditory localization, testing of hearing protectors and headgear systems for soldiers.

Current and Recent Research Projects & Sponsors

- Optimization of Engine Mounts for Vehicle Dynamics, NVH, and Durability (Ford).
- Vibration and Acoustic Analysis of Lawn and Garden Cab Structures (John Deere)
- Engine Encapsulation for Diesel Engines (Caterpillar).
- Study and Reduction of Interior Vibration and Noise in Excavator (Volvo CE).
- Sound Quality, Speech Intelligibility and Binaural Metric (ARL).
- Insertion Loss of Cab HVAC Duct elements (Caterpillar).

Professional Membership

American Society of Mechanical Engineers (ASME), American Society of Engineering Education (ASEE), SAE International (SAE), Institute of Noise Control Engineers (INCE/USA), and International Institute of Acoustics and Vibration (IIAV).

Service and Leadership:

- Associate Editor: International Journal of Vehicle Noise and Vibration, pub. Indersciences, 2003-present.
- Member of Organizing Committee: **2007, 2005, 2003, 2001, and 1999 SAE Noise and Vibration Conference**, Traverse City, Michigan.
- Member of Organizing Committee, Inter-Noise, August 2002, Dearborn, MI.
- Member of Organizing Committee: International Symposium and Workshop on Vehicle NVH, June 1996, Seoul, Korea.
- Member of Organizing Committee: Second and Third International Congress on Recent Developments in Air- and Structure Borne Sound and Vibration, Auburn, AL, March 4-6, 1992, and Montreal, Canada, June 13-15, 1994.
- Chair, Lab Committee, MTU. Developed new courses and Curriculum in the area Acoustic and Noise Control
- Director, Multidisciplinary-Engineered Dynamic System Research Caucus at MTU.

Subject: invite you
From: "Dr. M. L. Munjal" <munjal@mecheng.iisc.ernet.in>
Date: Tue, 28 Aug 2007 12:40:23 +0530 (IST)
To: mrao@mtu.edu

Dear Prof. Rao,

I have been following the good work that you have been doing for over two decades in the area of Environmental Noise Pollution Control, particularly the Automotive NVH. As you know, I have been Convener of the "Facility for Research in Technical Acoustics" (FRITA) in the Department of Mechanical Engineering at the Indian Institute of Science. We have been engaged in similar activities including Development of Quieter Technologies and Industrial and Environmental Noise Control, particularly the traffic noise pollution in the urban environment.

I have the pleasure to invite you during the next summer for duration of at least three months starting from 1st June 2008. During your stay here we would expect you to teach a course on Environmental Noise Pollution and we shall jointly develop lecture notes for senior undergraduate students in this area. You will also guide a couple of our students in the Technical Acoustics Laboratories of FRITA. We shall provide you local hospitality in our guest house and offer you a small honorarium. Unfortunately, we shall not be able to cover your international travel. You may try the Fulbright Scholar Programme for a supplementary grant to cover your international travel expenses. I can assure you that you will find your stay at IISc intellectually challenging and rewarding.

I shall look forward to your concurrence.

With kind regards,

Yours sincerely,

(M L MUNJAL)

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