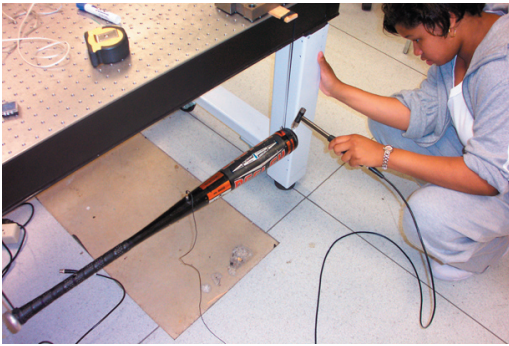


Program Logistics



The Future Engineers in Dynamic Systems (FEDS) Academy is a unique two-week summer educational program for junior and senior high-school students in the Baltimore region. It focuses on dynamics, vibration, acoustics, and system control in the mechanical engineering discipline. The academy will consist of ten students and take place in the Dynamic Systems and Vibrations Laboratory (DSVL) and surrounding classrooms at the University of Maryland, Baltimore County (UMBC). Students will be exposed to the state-of-the-art research and facility in the DSVL and engaged in thought-provoking experiments and lectures led by undergraduate and graduate teaching fellows. They will learn how engineering activities can be used for the betterment of life. This program is supported through a CAREER award from the National Science Foundation.



Location:

UMBC Department of Mechanical Engineering
Dynamic Systems and Vibrations Laboratory, Engineering 236



Date and Time:

June 17 - July 1, 2009, Weekdays Only, 9:00 a.m. - 4:00 p.m.

Cost: Free

Students are responsible for their own lunch and transportation to and from the UMBC campus.

Eligibility Requirements:

Rising high-school juniors and seniors with an interest in pursuing an engineering degree.



Application Deadline: April 30, 2009

Applications can be submitted via e-mail to wzhu@umbc.edu or mailed to:

Dynamic Systems and Vibrations Laboratory
1000 Hilltop Circle
Engineering 236
Baltimore, MD 21250
Attn.: FEDS Academy



For More Information Contact:

Dr. Weidong Zhu
UMBC Department of Mechanical Engineering
1000 Hilltop Circle
Baltimore, MD 21250
Telephone: 410-455-3394
E-mail: wzhu@umbc.edu

UMBC is an affirmative action/ equal opportunity employer. Women, minorities, and individuals with disabilities are encouraged to apply for positions.



CURRICULUM MODULES

1) Dynamics and control of elevator systems

Students will learn how to create a movement profile and program it on a scaled elevator. They will be shown animated wave motions in elevator cables and measurements from the scaled elevator. They will learn what scaling laws are, why elevators can experience vibration and noise problems during upward movement, and how a passive damper can effectively dissipate the vibration.

2) Vibration measurement of a beam

Students will learn how to set up and use modal testing equipment such as accelerometers, dynamic signal analyzers, signal conditioners, and impact hammers. They will learn about boundary conditions and why their idealizations are not always correct. They will learn the roving hammer and roving accelerometer testing techniques and their advantages and disadvantages.

3) Vibration and acoustics of guitar strings

Students will learn how to use a non-contact capacitance probe and a microphone to measure the natural frequencies of a guitar string. They will learn how to calculate the natural frequencies of a guitar string and estimate the tension in the string. They will learn the fundamentals of musical scales and how they are related to what they measure.

4) Acoustics of the human voice

Students will learn how to record the human voice using a microphone. They will learn about the spectra associated with different consonant and vowel sounds. They will learn why different peoples voices sound different, how, through the use of Matlab, they can make their voices sound different, and what effect this has on the spectra associated with their voices. Students will also learn some basic concepts about acoustics.

5) System Control and Design

Students will learn some basics about feedback control systems. They will learn how to use modern control hardware and software and a laser-based non-contact measurement system. They will also learn how one well-placed damper or controller can effectively dissipate a large number of vibration modes, and the difference between passive and active control. Students will also learn about system design and control using Lego Mindstorms.

6) System identification and structural damage detection

Students will learn about some nondestructive evaluation methods and how to use vibration-based methods to monitor structural health. They will be given a basic introduction to the finite element method using OpenFEM and the related mathematical concepts about model updating and damage detection. Through simulation and actual experiments they will learn how to use an iterative algorithm developed in-house to accurately detect the locations and extent of damage in a beam using changes of natural frequencies.

Final Project

The last five days will be allotted for a team project, where students can get practical hands-on experience and develop team-building skills. Five students will be grouped in one team. Students can select a project based on the modules. For instance, using the knowledge from the second module, students can choose to study the dynamics of a baseball bat and measure its “sweet spot,” which is the region between the nodes of the first two vibration modes. Students can validate that the location results in the least sting in the batter’s hands and maximum energy transfer to the ball. They can also conduct a modal test on a modular four-bay space frame. A short report connecting theory and application and a presentation will be required for each team to develop students’ communication skills.