



# Structural Health Monitoring

## Short Course

8-10 June 2009

Penn State University  
University Park, Pennsylvania

An excellent opportunity for Aerospace, Mechanical, and Civil Engineers to learn about:

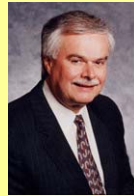
- SHM methods and systems
- Material behavior
- Modeling material damage
- Life prediction
- Sensory systems
- Ultrasonic guided waves
- Vibration monitoring
- Signal processing & data fusion
- Diagnostics & prognostics

Sponsored by the  
Center of Excellence in  
Structural Health Monitoring  
[www.esm.psu.edu/shm](http://www.esm.psu.edu/shm)

## About the Instructors

### Prof. Joseph Rose, Engng

**Science & Mechanics ...** Paul Morrow Professor, researches ultrasonic guided waves and associated technologies including sensors, phased arrays, tomography



### Dr. Karl Reichard, Applied

**Research Laboratory ...** complex systems monitoring and automation, prediction of health of mechanical and electrical systems, intelligent autonomous systems



### Prof. Martin Trethewey,

**Mechanical Engng ...** condition based machine health monitoring, analysis of machine dynamics from experimental data



### Prof. Charles Bakis, Engng

**Science & Mechanics ...** Distinguished Professor, Dir. of Composites Lab, design, manufacture, test, and analysis for lightweight structures and concrete reinforcement



**Prof. Francesco Costanzo, Engng Science & Mechanics...**, damage and fracture mechanics modeling across length scales, micromechanics



**Prof. Cliff Lissenden, Engng Science & Mechanics...** director of the Center of Excellence in Structural Health Monitoring, researches guided waves for monitoring composites and material behavior



**SHM** is the continuous or regular monitoring of the condition of a structure or system using built-in or autonomous sensory systems, and any resultant intervention to preserve structural integrity. The goal of SHM is to improve public safety, reduce maintenance costs, improve readiness, and foster a paradigm shift in design. While SHM is a broad multidisciplinary field both in terms of the diverse science and technology involved as well as its varied applications, there are fundamental concepts associated with a successful SHM system. Toward this end, SHM system developers and users should have a firm grasp of:

- Material behavior, especially its damage and failure modes,
  - Sensory systems appropriate for characterizing material state and its evolution,
  - Basic models for material, component, and system degradation and remaining life,
  - Data driven prognostics for complex systems.
- The SHM short course will introduce students to each of these and then develop in detail a few of the elements.

**Course Objectives:** Students will be able to...

1. describe and compare various types of diagnostics for SHM applications
2. select a viable SHM methodology for a given application based on available technology
3. apply the mechanics of guided waves for SHM applications to detect structural defects
4. analyze vibration data from a complex system and use it to predict remaining fatigue life

**Monday, June 8 9:00 am - 8:00 pm**

- Welcome & Introduction (Prof Lissenden)
- SHM Overview: history, fields, technologies, and applications (Prof Lissenden)
- SHM Framework: material/component/system behavior, diagnostics, prognostics (Prof Lissenden)
- Lunch
- Material behavior fundamentals (Prof Lissenden)
- Composite materials (Prof Bakis)
- Damage mechanics (Prof Costanzo)
- Mechanical testing lab
- Picnic

**Tuesday, June 9 8:00 am - 4:00 pm**

- Introduction (Prof Rose)
- Ultrasonic guided wave theory (Prof Rose)
- Experiment set I
- Ultrasonic guided wave theory (Prof Rose)
- Lunch
- Experiment set II
- Ultrasonic guided wave SHM applications (Prof Rose)
- Experiment set III

Free time to explore Centre County on your own (hiking, boating, golf, etc)

**Wednesday, June 10 9:00 am - 4:30 pm**

- Introduction (Prof Reichard/Trethewey)
- Dynamical systems and vibrations (Prof Trethewey)
- Fatigue life prediction (Prof Lissenden)
- Lunch
- Prognostics I - moving from diagnostics to prognostics (Prof Reichard)
- Prognostics II - signal processing and data fusion approaches (Prof Reichard)
- Prognostics III - system examples (Prof Reichard)
- Closure (Prof Lissenden)

Instructors will assume that students have a B.S. degree in one of the engineering disciplines.

**Registration Form**

- |   |            |
|---|------------|
| <input type="checkbox"/> SHM Center Member Registration | No charge* |
| <input type="checkbox"/> Full Registration Fee          | US \$1495  |
| <input type="checkbox"/> Full-time Student Registration | US \$695   |

\*members of the Center of Excellence in Structural Health Monitoring are eligible to send two people to the short course for free.

Course fee includes refreshments, lunches, the reception/dinner, handouts, and certificate.

Name:
Company:
E-mail Address:
Mailing Address:
City/State/Zip:
Phone Number:
Method of Payment:    check    VISA    MC    .

Direct questions to Cliff Lissenden ([Lissenden@psu.edu](mailto:Lissenden@psu.edu)) or Ed Smith ([ecs5@engr.psu.edu](mailto:ecs5@engr.psu.edu))

Fax completed registration form to: (814) 865-9974

Or mail to: 212 EES Bldg, University Park, PA 16802

Call Cliff Lissenden (814) 863-5754 to pay by credit card or make checks payable to: Penn State University

