Increasingly, military, corporate and government organizations are adopting a condition-based approach to assuring the operational readiness and safety of their most critical assets.

Rather than relying on human inspection and timed maintenance alone, the emerging field of Structural Health Monitoring and Prognosis (SHMP) involves acquiring structural vibration data coupled with validated simulation models of failure mode behavior and expected service states so that a prediction about the remaining useful life of the structure may be developed. Such SHMP systems can reduce operations and maintenance costs in a way that supports intelligent asset life cycle management.

The UC San Diego Master of Advanced Study program in Structural Health Monitoring is the first of its kind for engineering professionals, providing a multidisciplinary, integrated education in the theory and tools of SHMP. Such SHMP systems can reduce operations and maintenance costs in a way that supports intelligent asset life cycle management.

COURSES TAUGHT BY UC SAN DIEGO AND LOS ALAMOS NATIONAL LABORATORY EXPERT FACULTY, MANY OF WHOM HAVE EXPERIENCE CREATING STRUCTURAL HEALTH MONITORING SYSTEMS FOR CRITICAL DEFENSE ASSETS.
Structural Health Monitoring  
Master of Advanced Study Degree

About the Master of Advanced Study
The Master of Advanced Study (MAS) program in Structural Health Monitoring is designed for engineering professionals in civil and defense industries, who are responsible for maintaining the safety and reliability of key structural systems and assets. The program is targeted for early and mid-career engineers who work in small consultancy teams to define a structural health monitoring application need and propose and execute the optimal solution.

Who Should Apply
The Master of Advanced Study (MAS) program in Structural Health Monitoring is designed for engineering professionals in civil and defense industries, who are responsible for maintaining the safety and reliability of key structural systems and assets. The program is targeted for early and mid-career engineers who are on a technical leadership track within their organizations.

How to Apply
Visit http://maseng.ucsd.edu/shm for complete application procedures.

Faculty Directors

Michael Todd  
Professor and Vice-Chair  
Structural Engineering

Truong Nguyen  
Professor  
Electrical and Computer Engineering

Charles Farrar  
Adjunct Professor  
Structural Engineering  
Engineering Institute Leader,  
Los Alamos National Laboratory

Coursework
The MAS in Structural Health Monitoring is a 36-unit degree program which consists of nine 4-unit courses. The program begins fall quarter and can be completed in two years of consecutive fall, winter and spring quarters; no courses are conducted during the summer. The second year culminates in the presentation of the team capstone project in the final spring quarter. The capstone team project (4 units) requires a combination of in-class, laboratory, and off-campus work. It provides an opportunity for students to integrate knowledge acquired over previous quarters in a written report and oral presentation. (Curriculum subject to minor changes.)

Year One
Digital Signal Processing
Review of discrete-time systems and signals, Discrete-Time Fourier Transform and its properties, the Fast Fourier Transform, design of Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, implementation of digital filters.

Digital Signal Processing I
Discrete random signals; correlation and power spectral density functions. Conventional (FFT based) spectral estimation; coherence and transfer function estimation. Statistical analysis of time series; tests for stationarity and normality. Minimum mean-square error (MMSE) and least-squares (LS) estimation. Linear prediction; Levinson-Durbin algorithm; lattice filters. High resolution spectral estimation; model-based approaches; AR/ARMA modeling; minimum variance spectral estimation. Adaptive filtering; eigenvalue/eigenvector decompositions; LMS algorithm; noise cancelling.

Structural Dynamics and Vibration

Digital Image Processing
Image representation, quantization and sampling, image transforms, image enhancement, image compression, image processing.

Year Two
Computational Techniques in Finite Elements
Practical application of the finite element method to problems in solid mechanics including basic preprocessing and postprocessing. Topics include element types, mesh refinement, boundary conditions, dynamics, eigenvalue problems, and linear and nonlinear solution methods.

Sensing and Nondestructive Evaluation
Theory of electrical resistance strain gages, full-field coherent optical methods including photoelasticity, moiré and speckle interferometry, thermography and fiber optic sensing. Applications to materials characterization, defect detection and health monitoring of structures with emphasis on fiber reinforced composites.

Validation and Verification of Computational Models
Methods applied to the verification and validation of predictive numerical simulations with an emphasis on testing and finite element analysis for Structural Dynamics. Areas covered include code verification, solution verification, feature extraction, test-analysis correlations, statistical modeling, meta-modeling, calibration, and assessment of prediction accuracy. The quantification of uncertainty, both in the forward mode and inverse mode is also addressed.

Capstone Project: Integrated Structural Health Monitoring
Students will work to integrate all components of the structural health monitoring paradigm as it applies to structural and mechanical systems. Using a combination of Matlab-based exercises, web/literature research, and presentations, students will work in small consultancy teams to define a structural health monitoring application need and propose and execute the optimal solution.

Structural Reliability and Risk Modeling
Probability theory and random processes; fundamentals of structural reliability theory. Modern methods of structural reliability analysis including computational aspects; structural component and system reliability. Reliability-based design codes; structural modeling for performance and safety. Risk analysis of structural systems.

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