



UC-SDRL Experimental Techniques Seminar Series

Structural Measurements May 17-19, 2017

Modal Analysis May 22-24, 2017

FRF and Modal Model Applications Upon Request

Course Description

In the effort to solve vibration and noise problems in today's advanced machines, vehicles and structures, experimental modal analysis provides a means for modeling and modifying complicated dynamic behavior. This seminar series is intended to provide a thorough coverage of experimental techniques including measurement and digital signal processing concepts, structural dynamics theory, modal parameter estimation techniques, and application of frequency response function and modal models suitable for practical vibration analysis problems.

Experimental techniques are an important tool in the product design and development cycle. Complex structural vibration problems can be identified and the results can be used to update analytical models. Modern digital systems provide the opportunity to incorporate measurement, analysis and data display into a format which gives engineers a tool to help solve problems including:

- Characterization of industrial process dynamics
- Automotive vibration and noise reduction
- Machine tool vibration and chatter analysis
- Aircraft flutter and ground vibration testing
- Interaction of structural vibration with control systems
- Vibration of buildings and large structures
- Analysis and trouble-shooting of rotating machinery
- Modeling dynamic behavior of space vehicles

Who should attend?

Structural Measurements

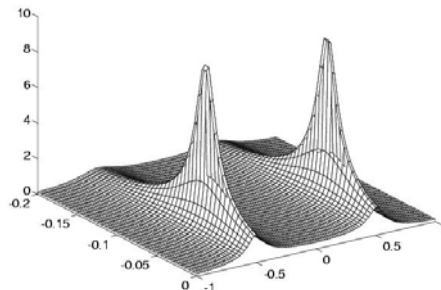
For any practitioner who needs to understand the advantages and limitations of different measurement techniques or needs to make measurements suitable for modal analysis and/or operating data applications in the shortest time possible.

Modal Analysis

For any practitioner, beginner to experienced, experimental or analytical, who wishes to review modal analysis theory and to understand the advantages and limitations of different experimental modal analysis techniques and modal parameter estimation algorithms.

FRF and Modal Model Applications

For practitioners with some experience with measurement and modal analysis who wish to understand the advantages and limitations of different experimental modeling techniques and other related applications.



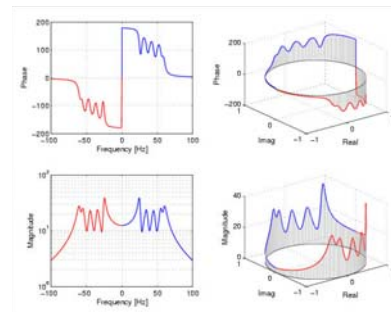
Seminar Series—Course Outlines

Structural Measurements

- Fourier Analysis
 - Discrete vs. Integral Transforms
- Digital Signal Processing
 - Windowing
 - Averaging, Triggering
 - Error Analysis
- Structural Measurements
 - Power Spectra
 - FRF (H_1 , H_2 , H_v)
 - Single/Multiple Input
 - Coherence (Ordinary/Multiple)
- Excitation Techniques
 - Shaker Testing
 - Impact Testing
 - Optimum Input Evaluation
 - Operating Excitation
- Operating Measurements
 - Power Spectral Density
 - Cepstrum, Quefrency
 - Time Spectral Map (Spectrogram)
- Non-Linear System Issues
- Rotating System Analysis
 - RPM Spectral Map
 - Instantaneous Velocity Algorithms
 - Order Analysis/Tracking
 - Kalman Filtered Order Tracking
 - TVDFFT Order Tracking

Modal Analysis

- Experimental Modal Analysis Theory
 - FRF vs. MCK Models
 - Modal Scaling (**Modal Mass versus Modal A**)
 - IRF (Time Domain) Models
 - FRF (Frequency Domain) Models
 - Advanced Issues (Repeated Roots, etc.)
- Modal Parameter Estimation
 - SDOF Methods
 - MDOF Methods, Single/Multiple Reference
 - Unified Matrix Polynomial Approach (UMPA)
 - Orthogonal Polynomials
 - Poly LSCF (PolyMax, RFP-Z)
 - Autonomous Modal Parameter Estimation**
- Modal Parameter Validation
 - Modal Assurance Criterion (MAC, COMAC)
 - Mode Indication Functions (MvMIF, CMIF)
 - Modal Vector Complexity Plots (MVCP)**
 - Error Evaluation
- Response Only (Operating) Modal Analysis
 - Time Domain Methods
 - Frequency Domain Methods
 - Specialized Data Processing
- Non-Linear System Issues



FRF and Modal Model Applications

- Structural Measurement Issues
- Modal Parameter Estimation Issues
- Sensitivity Analysis
- FRF Model Applications
 - Impedance/Compliance Modeling Theory
 - Inverse FRF Technique Theory
 - Demonstration Example
- Modal Model Applications
 - Modal Modeling Theory
 - Real/Complex Mode Issues
 - Demonstration Example
- Finite Element Modeling Validation
 - Modal Modeling Validation/Correction
 - FRF Modeling Validation/Correction
- Non-Linear System Modeling

Seminar Series—General Info

Registration

Each course is limited to thirty participants. All spaces in the course are reserved: attendees must register in advance. A tentative reservation may be made by telephone call to the course administrator, but no reservation is guaranteed until receipt of payment or company purchase order covering the course fee.

Fee

The fee for each course is \$1400. This payment includes the course notebook and references, noon meals (three days), and refreshments at break periods. No discounts will be given to those who do not wish to accept the course materials, meals, or refreshments. The course materials will not be published, and are not available except to course participants.

Fellowship

Any full-time faculty member or full-time graduate student from an accredited university may apply for a fellowship to reduce the required fee. This fellowship, if awarded, pays one half of the fee. Written applications should be submitted along with verification of fulltime status at least thirty days prior to the course.

Refund

The full fee will be refunded upon cancellation of an attendee's registration at least fourteen days before the start of the course. Later cancellation will incur a processing fee of \$50.

Location

The course is held on the campus of the University of Cincinnati, located adjacent to Clifton Avenue approximately two miles north of the business district of Cincinnati. All activities take place in Rhodes Hall which is part of the engineering complex at the University. Lectures are held in a classroom setting and afternoon demonstrations are held in the SDRL main laboratory. Any further information or services can be obtained from the Course Administrator.

Housing

A list of local hotels and motels is available through the UC-SDRL website (www.sdrl.uc.edu).

Course Administrator

The Course Administrator handles all questions regarding registration and housing. During the course, messages can be left for an attendee with the Course Administrator.

Mail all registration materials to:

UC-SDRL Seminar Series Coordinator
PO Box 210072
Cincinnati, Ohio 45221-0072
Phone: (513) 556-2725
Fax: (513) 556-3390
Email: sdrl-seminar@uc.edu

Course Director

The Course Director handles all questions regarding the technical content of the course. If you need further details on what is covered by each course, please contact the Course Director.

Randall J. Allemang, PhD
Structural Dynamics Research Laboratory
University of Cincinnati
PO Box 210072
Cincinnati, Ohio 45221-0072
Phone: (513) 556-2725
Email: Randall.Allemang@UC.EDU

On-site Course Options

Any of the seminars can be given at your site or customized to provide a specialized seminar based upon your needs. The cost of this type of seminar becomes cost effective once 6-8 attendees are involved. Please contact the course administrator for more details.

Lectures

Lectures are given by the various members of the staff of the Structural Dynamics Research Laboratory, as well as prominent authorities from the experimental techniques community. In the past, invited lecturers have come from Agilent Technologies, Anatrol Corporation, The Boeing Company, Chuo University (Tokyo, Japan), Entek Corporation, Hewlett-Packard Corporation, Leuven Measurement Systems, MB Dynamics, The Modal Shop, PCB Piezotronics, Vold Solutions, Structural Dynamics Research Corporation, the University of Massachusetts - Lowell (Lowell, Massachusetts) and the University of Leuven (KUL, Leuven, Belgium).

For details on the specific lecturers included in the current course, please contact the Course Administrator or Course Director. Those members of the staff lecturing in each short course include: Dr. Dave Brown, Dr. Randy Allemang, Dr. Bob Rost, and Dr. Allyn Phillips. Various Doctorate and Masters candidates assist with the demonstrations in their areas of research.

Demonstrations

All demonstrations are given using UC-SDRL equipment and Matlab® based software, including X-Modal III (with embedded data acquisition) developed by UC-SDRL for education and research purposes. UC-SDRL equipment includes hardware from HP, Agilent Technologies, MB Dynamics, PCB Piezotronics, The Modal Shop, National Instruments and VXI Technology is used in the demonstrations.

Registration Information (Registration is available online at www.sdrl.uc.edu)

Name: _____
Title: _____
Company: _____
Division: _____
Street Address: _____
City, State, Zip: _____
Telephone: _____
Email Address: _____

- Structural Measurements (\$1400)
- Modal Analysis (\$1400)
- FRF and Modal Model Applications (\$1400) - Not scheduled at this time

- Payment Enclosed (payable to University of Cincinnati—SDRL)
- Purchase Order Enclosed Credit Card (VISA/MasterCard)

CC details can only be transmitted by telephone
(513-556-2725) or on-site during registration.

Name on Card: _____

Questionnaire

Brief Job Description: _____
Educational Background: _____
Experimental Experience: _____
Reason for Enrollment: _____