New hands-on SHM software sessions!
Reference text provided!

Los Alamos Dynamics, **Structural Dynamics Consultants (www.la-dynamics.com)**

Announces a Three-Day Short Course:

Structural Health Monitoring Using Statistical Pattern Recognition!

Palo Alto, California, September 9-11, 2017

Structural Health Monitoring Using Statistical Pattern Recognition will introduce engineers to the field of damage assessment (detection, location, severity) in structures as determined from changes in their measured dynamic response. In addition to the historical motivation and development of the methods, the course will cover the theory, application, and computerized implementation of this technology **with hands-on software exercises.** Many real-world examples and results will be presented from the fields of aerospace, civil, and mechanical engineering. The application of statistical pattern recognition techniques will be emphasized throughout the course.

Course Material Provided: notebook, CD with color copy of notes, software, data sets and **reference book: *Structural Health Monitoring: A Machine Learning Perspective***

Course Goals:

- Describe structural health monitoring in terms of statistical pattern recognition paradigm.
- Understand how this technology has emerged from aerospace, civil and mechanical engineering applications.
- Understand the sensing technology used for SHM and new sensing technologies being developed specifically for SHM.
- Understand the primary data features used to identify ,locate and quantify damage.
- Discuss the practical implementation issues, including the influence of operational and environmental variability on the SHM process
- Understand different statistical classification tools that can be used in the SHM process.
- Understand the concepts of optimal SHM system design and performance assessment
- **Reinforce lecture material through "hands-on" examples analyzing experimental data sets**

This course is designed for those who seek a thorough understanding of the analytical techniques for SHM as well as an appreciation for practical implementation issues.

Topics Covered (see course outline & instructor bios at www.la-dynamics.com)

1. Introduction
- Motivation for SHM
- Relation between NDE & SHM
- Fundamental axioms
- Statistical pattern recognition paradigm
- Historical overview

2. Background Material
-Review of NDE
-Review of signal processing
-Review of basic statistics
-Machine learning basics

3. Operational evaluation
- Define System Specific Damage
- Economic/life-safety justification
- Evaluate sources of variability
- Case studies

4. Sensing & Data Acquisition
- Sensor network components
- Sensor performance metrics
- Signal conditioning issues
- Sensor system design criteria

5. SHM Sensing Technology
- Embedded Systems
- Processing & Telemetry
- Piezoelectric sensing
- Fiber optics
- Emerging sensing technologies

6. Ultrasonic SHM Methods
- Acoustic Emission
- Impedance Method
- Guides Waves
- Nonlinear Acoustics

7. Software Hands-on Exercises
- Software overview
- Signal conditioning
- Feature extraction
- Detection & classification

8. Damage Sensitive Features
- Feature selection criteria
- Feature vs metric
- Feature categories
- Examples (linear/nonlinear)

9. Statistical Classification Methods
- Supervised/unsupervised learning
- Novelty detection
- Hypotheses testing
- Machine learning methods

10. Data Normalization
- Sources of variability
- Modeling of environmental effects
- Machine learning approaches

11. SHM System Design
- Bayes risk framework
- Detector design
- Probability of detection
- Robustness assessment

The instructors will assume a basic knowledge of structural mechanics, dynamics and mathematics obtained in a bachelor's aerospace, civil or mechanical engineering curriculum