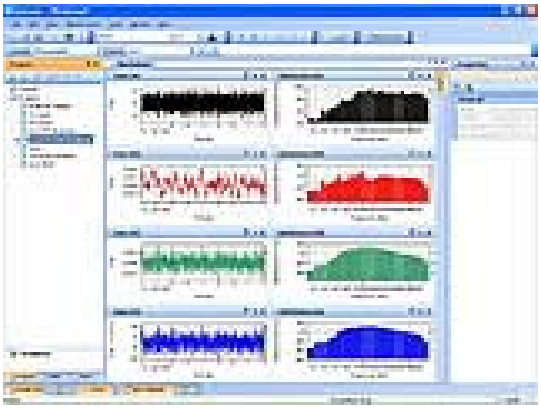
THE CENTER FOR
PROFESSIONAL STUDIES



Sound Engineering Test and Analysis

Product sound and sound quality are key aspects of product perception. How a product sounds plays a critical role in conveying the right message about its functionality, comfort, overall brand image and its quality. Regulations and competitive pressure have forced manufacturers to keep noise levels within limits and meet increasingly stringent sound standards. Sound engineers look for more productive testing and analysis solutions to quickly and effectively identify root causes of existing sound issues and help them efficiently design products that transmit the right brand message.

In the world of sound engineering, "one size fits all" is not applicable. This is not surprising since sound engineering addresses an extensive range of sound issues in everything from cars to gardening equipment, dishwashers to snowmobiles, and aircrafts to personal computers.

- First, the basics of sound quality testing and analysis

- Next, participants will focus on;
  - Multi-channel sound level meter and octave analysis
  - Material and component testing
  - Sound power and certification measurements
  - Sound source localization
  - Sound quality and brand sound engineering

- Lastly, participants will be shown how to run the model and interpret output results on LMS software products. A thorough understanding of what these results mean and how to use them to improve the product design will be discussed.

THE CENTER FOR PROFESSIONAL STUDIES

Course Syllabus

I IDENTIFYING INFORMATION

Course:	Sound Engineering
Prerequisite:	Digital Signal Processing in Noise and Vibration Testing
Time Frame:	40 total contact hours
Instructor:	A senior technical specialist with LMS International 5 years of experience with LMS software 5 years of applicable industrial experience
Phone:	(248) 952-5664
E-mail:	testsupport.us@lmsintl.com

II REFERENCE MATERIALS

1. LMS software usage documentation

III COURSE GOALS AND OBJECTIVES

1. Introduce sound engineering.
2. Understand sound pressure and sound power.
3. Learn source identification techniques
4. Understand the concepts behind sound quality.
5. Identify materials for use in sound engineering

IV METHODOLOGY

This course will demonstrate several aspects of sound quality testing and analysis. This will be done by introducing the six S's: Sound Pressure, Sound Power, Sound Source Identification, Sound Quality, Sound Materials and Source-Path-Receiver. Each module will introduce new material that the student will be allowed to experience for himself with the associate In-class Tutorials.

Lectures

Each detailed subject will be presented in a lecture format outlining the theory and standardized accepted methodology. A printed copy of the lecture material will be provided for the student's personal in-class use and as a reference material.

Specific Industry Examples

Real life examples will be covered that explain the application of the theory to various industries such as automotive, aerospace, home appliance or ground vehicle. This will give the students a clear understanding of how and why these techniques are utilized in different industries and the value they add to sound enhancement.

In-Class Assignments

The student will conduct several hands-on tutorials to reinforce the theoretical concepts. These tutorials will increase in complexity as the students further develop their skills.

V COURSE OUTLINE & ASSIGNMENTS

Module 1 – An Introduction to Sound Engineering

Sound Engineering: The six S's
Sound Propagation
Sound Waves
Sound Pressure, Intensity, Power
Sound Levels: The Decibel
Combining Sound Levels
Sound Materials and Noise Control
Source-Path-Receiver
Measurement of Sound
Sound Level Meters
Microphones
Measurement Controls; Meter Speed, Gain, Weighting, Scaling
Sound Fields; Free vs. Diffuse
Sound Spectrum Analysis
Narrowband and Octave Filters
In-class Tutorials:
– Microphone Calibration
– Measuring a Steady Tone; Comparing Different Weightings and Speeds
– Measuring the Speed of Sound
– Effect of Doubling Sources and Distances
– Sound Spectrum; Octave and Narrowband Compared

Module 2 – Sound Intensity Testing and Analysis

Sound Intensity Theory
Creating an Acoustic Mesh
Sound Intensity Testing using Intensity Probes
Frequency Limits of Intensity Measurements
Sound Power using Sound Intensity
Sound Power using Sound Pressure
Comparison of Standards
In-class Tutorials:
– Sound Intensity Testing
– Sound Power Calculation

Module 3 – Sound Source Localization: Other Methods

- Presentation of Methods
- Practical Application Examples
- Beam forming, Holography, and Focalization Techniques
- Source Localization using Acoustic Arrays
- Source Localization using Spherical Arrays
- In-class – Tutorial – Sound Source Localization using an Acoustic Array

Module 4 – Sound Materials and Room Acoustics

- Sound Materials
- Propagation of Sound – Sound Absorption
- Impedance Tubes
- Sound Transmission Loss
- Reverberation Time
- In-class – Tutorial – Measuring Reverberation Time

Module 5 – Source – Path – Receiver

- Transfer Path Analysis
- Airborne vs. Structure borne Sources
- Transfer Functions and Operational Data
- Calculation of Loads

Module 6 – Sound Quality Introduction and Theory

- Physical Background
- Psychoacoustics
- Sound Quality Metrics
- Subjective Analysis
- Binaural Recording
- Binaural Replay
- In-class – Tutorial – Binaural Recording and Replay

Module 7 – Sound Quality Metrics

Loudness
Time Varying Loudness
Articulation Index and Speech Interference
Sharpness
Prominence Ratio
Tonality
Prominence Ration
Tone-to-Noise Ratio
Pitch
Noise Rating and Noise Criterion
Modulation Metrics; Roughness, Fluctuation Strength
Tracked Modulation Maps
In-class Tutorials:
– Sound Quality Metrics on Different Noise Sources
– Modulation Metrics