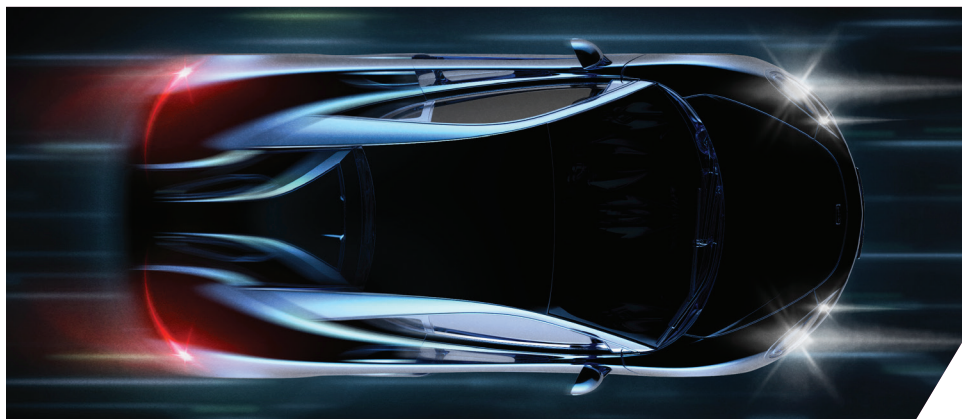


# NOISE, VIBRATION AND HARSHNESS TECHNOLOGY EDUCATION & TRAINING GUIDE

April - December 2017



## FEATURED COURSES

- Vehicle Noise Control Engineering Academy - Vehicle Interior Noise | [Page 12](#)
- Vehicle Noise Control Engineering Academy - Powertrain Noise | [Page 14](#)
- Vehicle Sound Package Materials | [Page 8 & 9](#)
- Brake Noise Problem Resolution | [Page 3](#)

PLUS—Explore Related Noise, Vibration, and Harshness Technology Resources on pages 18-19!

# HOW DO YOU STAY UP-TO-DATE AND SECURE TIMELY INFORMATION IN YOUR TECHNOLOGY FOCUS AREA

Look to SAE International as your most critical resource for lifelong training and professional development. In this issue of the *Noise, Vibration, and Harshness Education & Training Guide*, you'll find an extensive portfolio of courses designed to keep you ahead of the industry.

**PLUS - don't miss the suggested Related Noise, Vibration, and Harshness Technology Resources on page 18.** We've selected key SAE books, standards, journals, and technical events to further your professional development and deepen your technical knowledge:

## THIS GUIDE INCLUDES COURSES THAT EXPLORE THE FOLLOWING TOPICS

- Vibration analysis
- Hybrid and electric vehicle noise
- Vehicle interior noise and vehicle powertrain noise
- Diesel engine noise
- Brake noise and brake noise resolution
- Materials for noise control



## EARN A CERTIFICATE OF ACHIEVEMENT FROM SAE

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## WHY SAE? WHAT OUR CUSTOMERS ARE SAYING

*"This course refreshed my knowledge on the major vibration concepts and ultimately bridged the gap to performing analysis with FEA."*

(In reference to Vibration Analysis Using Finite Element Analysis (FEA) - page 7)

### **Benjamin Wibberley**

R&D Engineer, Nissan Brake Ohio

*"The instructor provided the unique perspective of historical signal processing background, personal work experience and knowledge of the latest analysis techniques to solve difficult NVH problems."*

(In reference to Practical NVH Signal Processing Methods - page 17)

### **Kevin Marsh**

NVH Engineer, Eaton Corporation

## SAE CUSTOMER SERVICE

Contact SAE Customer Service for any questions concerning schedules, fees, locations, or registration.

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## A LEARNING FORMAT TO FIT EVERY NEED

As the world's leader in offering access to the most extensive, multi-sector source of knowledge and expertise, SAE International provides the mobility engineering training and education needed to turn your challenges into solutions.

### What is your learning need?

SAE International offers a variety of learning formats to accommodate diverse learning styles. Explore classroom, live and online, and on demand courses.

Many courses are offered in multiple formats to fit your exact need. Be sure to watch for the icons that identify the format available for each course.

Seminars or workshops available as similar live, online web seminars or on demand courses, will feature icons and information about the schedule and fees for all platforms.

## CATALOG KEY

Look for the icons below included with the course descriptions. The icons indicate delivery formats for the course and whether the course is part of an SAE Certificate Program.

Many courses are available in multiple formats. In addition to finding courses that fit your technology need, look for courses with icons that fit the way you want to learn.



### CLASSROOM

indicates that course is an instructor-led seminar or workshop offered in a classroom setting



### LIVE, ONLINE

indicates this course is an instructor-led web seminar offered live and online via telephone and internet connection



### ON DEMAND

These offerings are available online anytime the participant would like to access the course through the internet



### CERTIFICATE

This icon indicates that this course is part of an SAE International curriculum-based, multi-course certificate.

As an IACET Accredited Provider, SAE International offers CEUs for its programs that qualify under the ANSI/IACET Standard.

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## WHAT IS “ON DEMAND”?

SAE International on demand offerings are a variety of full-length recorded seminars and web seminars, and short-course options that offer quick bits of learning – learning options that you can access anytime and anywhere you have a laptop and internet access. We are also proud to offer on demand courses from partner organizations like Ford, CALISO, and Industrial Metallurgists, LLC.

# BRAKE NOISE PROBLEM RESOLUTION



Brake noise is one of the highest ranked complaints of car owners. Consumer expectations and the high cost of warranty repairs are pushing the optimization of brake NVH performance. This course provides you with an overview of the various damping mechanisms and tools for analyzing and reducing brake noise. A significant component of this course is the inclusion of case studies which demonstrate how brake noise squeal issues have been successfully resolved.

## LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe the various brake shim damping mechanisms
- Compare the various brake shims available in the market place
- Describe the various tools available to reduce brake noise
- Utilize lessons learned in various brake noise problem case studies

## WHO SHOULD ATTEND

The course is designed for a wide range of personnel from the brake test engineer who seeks to understand more about brake NVH to the experienced brake NVH/design engineer who wishes to know more about potential solutions. Anyone involved in the resolution of brake noise problems will find this course helpful.

## CONTENT HIGHLIGHTS

- Brief Review of Brake Noise
- Types of brake noises
- Principles and Applications of Brake Shims
- Damping
- Tools for Brake Noise Analysis/Reduction
- Brake noise categorization
- Squeal
- Pressure distribution optimization
- Moan/Groan
- After-stop noise program -- Problem identification; Transmission of the road to the

## INSTRUCTOR

### Eric Denys

Vice President of Global OE Brakes and AM Integration, Wolverine Advanced Materials

Instructor Eric Denys has been published in numerous national and international papers and in an SAE book on Disc Brake Squeal. Eric is a Six Sigma Black Belt and is currently the chairman of the SAE Brake NVH Standards Committee.

### I.D.# C0831

#### SCHEDULE

April 21, 2017  
Troy, Michigan

September 29, 2017  
Orlando, Florida - *Held in conjunction with the SAE 2017 Brake Colloquium*

#### FEES

List: \$810

#### Members

Classic: \$729

Premium: \$689

Elite: \$648

#### ONE-DAY/.7 CEUS

**Get more information and register:**  
[training.sae.org/seminars/c0831/](http://training.sae.org/seminars/c0831/)

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[training.sae.org/corplearning](http://training.sae.org/corplearning)

# INTRODUCTION TO BRAKE NOISE, VIBRATION, AND HARSHNESS



Brake Noise, Vibration, and Harshness (NVH) is recognized as one of the major problems currently faced by the automotive manufacturers and their suppliers, with customers warranty claims of more than \$100 million per year for each manufacturer. With increasing consumer braking performance expectations, automotive OEM's and suppliers need the ability to predict potential problems and identify solutions during the design phase before millions of dollars have been spent in design, prototyping, and manufacturing tooling. This seminar provides an introduction to brake NVH, including a concise summary of the various brake NVH problems, current lab and vehicle measurement techniques and SAE global standards which are utilized to characterize the noise correctly in order to get the best option/solutions quickly. The information provided serves as a foundation for understanding and characterizing brake NVH issues and is an excellent primer to the SAE Seminar - *Brake Noise Problem Resolution* (ID# C0831) - see course description on page 3.

Customer warranty claims for Brake Noise, Vibration, and Harshness are more than \$100 million per year for each manufacturer.

## LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe NVH and brake NVH
- Identify the various brake NVH problems
- Describe the components of a brake NVH dynamometer
- Configure and perform dyno and vehicle brake NVH tests measurements
- Utilize SAE J2521, the only international standard for brake NVH dynamometer evaluation
- Interpret basic noise and vibration data in the time and frequency domain
- Explain the premise behind various SAE Standards related to brake NVH

## WHO SHOULD ATTEND

The information in this course is relevant to a wide audience, from the brake test technician who seeks to understand more about NVH and brake NVH, to the experienced brake NVH engineer who wishes to know more about the details of the tests performed and the meaning of the results. Brake development and brake component engineers who are not familiar with brake NVH will also find the course beneficial.

## CONTENT HIGHLIGHTS

- Basics of Noise and Vibration
- Basics of Brake NVH
- Basic Dynamometer Testing
- Vehicle Brake Testing
- Brake SAE NVH Standards Currently Released and Under Development
- SAE J2598 - Automotive Disc Brake Pad Natural Frequency and Damping Test
- SAE J2786 - Automotive Brake Noise and Vibration Nomenclature
- SAE J2933 - Verification of Brake Rotor Modal Frequencies
- SAE J3001 - Brake Insulator Damping Measurement Procedure
- Introduction to Brake NVH Problem Resolution

## INSTRUCTOR

### Eric Denys

Vice President of Global OE Brakes and AM Integration, Wolverine Advanced Materials

**I.D.# C1337**

## SCHEDULE

April 20, 2017

Troy, Michigan

September 28, 2017

Orlando, Florida - *Held in conjunction with the SAE 2017 Brake Colloquium*

## FEES

List: \$810

## Members

Classic: \$729

Premium: \$689

Elite: \$648

## ONE-DAY/.7 CEUS

**Get more information and register:**  
[training.sae.org/seminars/c1337/](http://training.sae.org/seminars/c1337/)

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# ACOUSTIC FUNDAMENTALS FOR SOLVING NOISE AND VIBRATION PROBLEMS



This web seminar provides an introduction to the characteristics of sound waves, human perception of sound, sound and vibration measurements, measurement facilities, and various noise sources and noise control principles. It includes an overview of sound pressure, power, intensity, decibels, and frequencies. The use of practical examples familiarizes you with the acoustic fundamentals for solving noise and vibration problems and the associated solution principles.

## LEARNING OBJECTIVES

By connecting with this web seminar, you will be able to:

- Discuss the differences of various acoustic terminologies that are important to solve noise and vibration problems
- Define a relationship between sound pressure, sound power, and sound intensity
- Associate decibel to both sound and vibration
- Prepare effective acoustic specifications encompassing all variables that affect noise and vibration
- Select correct instrumentation for noise and vibration measurements recognizing the challenges of measurements
- Define the source-path-receiver relationship
- Determine the steps of noise and vibration source identification process for a given application
- Employ different noise control options to address specific noise and vibration issues

## WHO SHOULD ATTEND

This fundamental web seminar will be especially valuable for technical staff, engineers, and managers with limited experience in noise and vibration.

## CONTENT HIGHLIGHTS

- Waves
- Pressure, power, intensity
- Frequency
- Decibels
- Human Perception of Sound
- Instrumentation and Facilities
- Various Noise Sources
- Noise Control Principles

## INSTRUCTOR

### Pranab Saha

Co-Founder and Principal Consultant,  
Kolano and Saha Engineers, Inc.

Train your whole team.  
Register one individual at the appropriate member or list price, then register the rest of the team for half off the list price. Contact SAE Customer Service for more info and to take advantage of this discount.

**I.D.# WB1309**

### SCHEDULE

April 19-26, 2017

Live Online

November 28-December 1, 2017

Live Online

### FEES

List: \$550

### Members

Classic: \$495

Premium: \$468

Elite: \$440

**THREE, 2-HOUR SESSIONS / .6 CEUS**

**Get more information and register:**  
[training.sae.org/webseminars/wb1309/](http://training.sae.org/webseminars/wb1309/)

## ALSO AVAILABLE AS AN ON DEMAND COURSE

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**I.D.# PD3313090N**

### FEES

See above

**6-HOURS/.6 CEUS**

**Get more information on this Web Seminar RePlay:** [training.sae.org/replays/pd3313090n/](http://training.sae.org/replays/pd3313090n/)



# VIBRATION ANALYSIS USING FINITE ELEMENT ANALYSIS (FEA)



This web seminar introduces vibration analysis performed with Finite Element Analysis (FEA). By considering time-dependent loads and inertial and damping effects, vibration analysis allows for a more in-depth product simulation thus reducing product development cost and time. The course reviews basic concepts of vibration analysis and illustrates how they are implemented in FEA to simulate product behavior.

## LEARNING OBJECTIVES

By connecting with this web seminar, you will be able to:

- Evaluate the importance of dynamic effects in product simulation
- Analyze inertial and damping effects in structural response
- Perform modal analysis, time response analysis and frequency response analysis
- Apply proper FEA modeling techniques to model system vibration
- Use vibration analysis as a design tool

## WHO SHOULD ATTEND

Design, R&D, project, and product engineers who already use Finite Element Analysis (FEA) as a design tool and would like to explore how vibration analysis with FEA may benefit the design process.

## CONTENT HIGHLIGHTS

- Structure vs. Mechanism
- Simulation Process with the FEA
- Verification and Validation of FEA Results
- Modal, Time Response, and Frequency Analyses
- Random Vibration
- Linear vs. Non-linear Vibration Analysis
- Modeling Considerations in Vibration Analysis

## INSTRUCTOR

### Paul Kurowski

Professor, Department of Mechanical and Materials Engineering, University of Western Ontario  
President, Design Generator Inc.

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"This course refreshed my knowledge on the major vibration concepts and ultimately bridged the gap to performing analysis with FEA."

### Benjamin Wibberley

R&D Engineer  
Nissan Brake Ohio

I.D.# WB1401

### SCHEDULE

June 5-16, 2017

Live Online

December 4-15, 2017

Live Online

### FEES

List: \$870

### Members

Classic: \$783

Premium: \$740

Elite: \$696

### SIX, 2-HOUR SESSIONS/1.2 CEUS

Get more information and register:  
[training.sae.org/webseminars/wb1401/](http://training.sae.org/webseminars/wb1401/)

# SOUND PACKAGE MATERIALS FOR VEHICLE NOISE CONTROL



This seminar provides a detailed analysis of three different classes of acoustical materials - absorbers, barriers, and dampers, and how they are different from each other. The seminar addresses new advances in acoustical materials that impact the vehicle acoustics, and covers ways to evaluate the acoustical performance of these materials using different test methods. The seminar starts with the fundamentals of NVH and sound quality related to sound package materials and discusses the importance of various noise sources that impact the development of sound package treatments in a vehicle.

## LEARNING OBJECTIVES

By attending in this seminar, you will be able to:

- Identify various descriptors that are used in NVH and sound quality while working with sound package materials
- Recognize various noise sources and paths in a vehicle
- Identify three different classes of acoustical materials
- Describe ways that acoustical materials work and how they differ from each other
- Road map for vehicle sound package development
- Distinguish test methods used to evaluate the acoustical performance of material

## WHO SHOULD ATTEND

This seminar is designed for those with responsibilities in the areas of manufacturing, design, engineering, process, noise and release engineering, supervision or management.

## CONTENT HIGHLIGHTS

- Fundamentals of NVH and Sound Quality
- Vehicles Noise Sources and Solutions
  - Noise control solution - source, path, receiver
  - Noise control system using sound package materials
- Materials for Vehicle Noise Control
- Different Automotive Measurements
  - Vehicle; Component; Material

## INSTRUCTOR

### Pranab Saha

Co-Founder and Principal Consultant,  
Kolano and Saha Engineers, Inc.

"This two-day seminar covered practical acoustics from A to Z."

### Jeff Anderson

Engineer  
Textron

## I.D.# 92032

### SCHEDULE

June 15-16, 2017  
Grand Rapids, Michigan - *Held in conjunction with the SAE Noise and Vibration Conference*

### FEES

List: \$1,370

### Members

Classic: \$1,233

Premium: \$1,165

Elite: \$1,096

### TWO-DAYS/1.3 CEUS

**Get more information and register:**  
[training.sae.org/seminars/92032/](http://training.sae.org/seminars/92032/)

**THIS COURSE IS ALSO AVAILABLE LIVE ONLINE AS AN SAE WEB SEMINAR. SEE COURSE DESCRIPTION ON PAGE 9.**

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# VEHICLE SOUND PACKAGE MATERIALS



This web seminar provides a detailed understanding of the source - path-receiver relationship for developing appropriate sound package treatments in vehicles and transportation devices. The web seminar provides a detailed overview of absorption, attenuation (barrier), and damping materials and how to evaluate their performances on material, component, and vehicle level applications. Case studies that demonstrate how properly designed sound package materials successfully address vehicle noise issues are a significant part of this course.

## LEARNING OBJECTIVES

By connecting with this web seminar, you will be able to:

- Identify various descriptors that are used in acoustics while working with sound package materials
- Identify three fundamentally different sound package materials used in the industry; explain how these materials work and how to improve their performance
- Describe how various measurements are made and why they are necessary on a material, component, and vehicle level
- Prescribe appropriate sound package materials for specific NVH issues
- Construct proper protocols for combining different sound package materials for different components so that the final vehicle meets the required acoustic target

## WHO SHOULD ATTEND

This web seminar will be especially valuable for those new to the vehicle sound package area. The web seminar is also designed for those involved with noise control materials and parts for mobility.

## CONTENT HIGHLIGHTS

- Vehicle Noise Sources and Solutions
  - The noise system - sources
  - Ranking noise paths
  - Source-path-receiver relationship
- Sound Package Material - Absorber, Barrier, Damper
- Component and Vehicle Level Noise Measurements

## INSTRUCTOR

### Pranab Saha

Co-Founder and Principal Consultant,  
Kolano and Saha Engineers, Inc.

“Relevant, realistic and informative.”

### Md Zakir Ahmed

Sr. Manager, Process Engineering  
Volkswagen India Pvt Ltd.

**I.D.# WB1204**

#### SCHEDULE

August 1-10, 2017

Live Online

#### FEES

List: \$640

#### Members

Classic: \$576

Premium: \$544

Elite: \$512

**FOUR, 2-HOUR SESSIONS/.8 CEUS**

**Get more information and register:  
[training.sae.org/webseminars/  
wb1204/](http://training.sae.org/webseminars/wb1204/)**

#### ALSO AVAILABLE AS AN ON DEMAND COURSE

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**I.D.# PD331204ON**

#### FEES

See above

**8-HOURS/.8 CEUS**

**Get more information on this Web  
Seminar RePlay: [training.sae.org/  
replays/pd331204on/](http://training.sae.org/replays/pd331204on/)**

# DIESEL ENGINE NOISE CONTROL



This web seminar provides an in-depth overview of diesel engine noise including combustion and mechanical noise sources. In addition, the instructor discusses a system approach to automotive integration including combining sub-systems and components to achieve overall vehicle noise and vibration goals.

## LEARNING OBJECTIVES

By connecting with this web seminar, you will be able to:

- Identify and analyze commonly occurring diesel engine noise sources
- Understand how analytical and experimental techniques can be used to solve diesel noise issues
- Prescribe appropriate noise control analysis and solutions for specific diesel engine NVH issues

## WHO SHOULD ATTEND

This web seminar is ideal for those who want to understand the root causes of many diesel engine noise issues, and how to use this understanding to better diagnose and control diesel engine-related noises.

## CONTENT HIGHLIGHTS

- The Basics of Diesel Engine Noise
- Combustion Noise Forcing Functions
- Combustion Mode Switching
- Mechanical Forcing Functions in Diesels
- Separating Combustion and Mechanical Noise Sources
- Strategies for Reducing Forcing Functions
- Surface Radiated Noise
- Exterior Covers: Radiated Sound and Simulation Modeling
- Gear Train Noise Issues and Countermeasures
- Drive-By Noise Contribution
- Diesel Engine Design Considerations for Low Noise
- Application Noise Issues

## INSTRUCTOR

### Thomas Reinhart

Program Manager for NVH in the Engine, Emissions, and Vehicle Research division, Southwest Research Institute

“This was a great web seminar for introduction into engine noise sources and paths, as well as techniques used to improve engine NVH quality.”

### John Roxworthy

Sound Development Engineer  
Caterpillar, Inc.

### I.D.# WB1041

#### SCHEDULE

August 15-17, 2017  
Live Online

#### FEES

List: \$425

#### Members

Classic: \$383

Premium: \$361

Elite: \$340

#### TWO, 2-HOUR SESSIONS/.4 CEUS

Get more information and register:  
[training.sae.org/webseminars/wb1041/](http://training.sae.org/webseminars/wb1041/)

#### ALSO AVAILABLE AS AN ON DEMAND COURSE

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### I.D. # PD3310410N

#### FEES

See above

#### 4-HOURS/.4 CEUS

Get more information on this Web Seminar replay: [training.sae.org/replays/pd331041on/](http://training.sae.org/replays/pd331041on/)

# INTRODUCTION TO NVH ASPECTS OF HYBRID AND ELECTRIC VEHICLES



While developing the NVH behavior of the vehicle is critical to satisfy customer expectations, it is also important to consider the influence of reduced exterior noise levels on pedestrian safety. This seminar introduces you to basic NVH principles and unique NVH challenges encountered in the development of HEV, ReEV, and EV including engine start/stop behavior, electric motor whine, driveline NVH, body structure, influence of noise from accessories, and sound quality development, as well as potential countermeasures.

## LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Articulate the basic principles of NVH
- Describe the relative importance of powertrain noise, wind noise, and road noise in the vehicle's interior
- Identify the key sub-components of powertrain noise and means to control them
- Explain the key NVH issues specific to electrified vehicles and means to develop appropriate countermeasures
- Identify key metrics available to assess the NVH performance of electrified vehicles
- Develop an awareness of advanced NVH methodologies available to design the sound character of electrified vehicle

## WHO SHOULD ATTEND

This seminar has been developed for engineers involved in all fields related to the design or development of electrified vehicles.

## CONTENT HIGHLIGHTS

- Automotive NVH Fundamentals
- Fundamentals of noise, vibration, and sound quality
- Powertrain-induced interior noise
- Engine, transmission, and driveline noise
- Intake and exhaust noise, road-induced noise
- "Road Map" for vehicle NVH development of HEV, ReEV, PHEV, and EV
- HEV/EV driveline NVH using case study examples
- Application of powertrain-induced vehicle interior noise simulation

## INSTRUCTOR

### Kiran Govindswamy

Director of NVH, Driveline and Vehicle Integration, North American Technical Center of FEV, Inc.

The influx of different hybrid and electric vehicle configurations has brought about unique NVH challenges from a variety of sources.

## I.D.# C1128

### SCHEDULE

June 15, 2017

Grand Rapids, Michigan - *Held in conjunction with the SAE Noise and Vibration Conference*

November 6, 2017

Troy, Michigan

### FEES

List: \$810

### Members

Classic: \$729

Premium: \$689

Elite: \$648

### ONE-DAY/.7 CEUS

**Get more information and register:**  
[training.sae.org/seminars/c1128/](http://training.sae.org/seminars/c1128/)

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# VEHICLE NOISE CONTROL ENGINEERING ACADEMY - VEHICLE INTERIOR NOISE



This Engineering Academy covers a variety of vehicle noise control engineering principles and practice. Two specialty tracks are available: Vehicle Interior Noise and Powertrain Noise. The Vehicle Interior Noise track focuses on the understanding and application of acoustical materials to optimize NVH in the passenger or operator compartment of a vehicle. Considerable attention is given to current measurement and instrumentation technologies and their effective use.

## Practical Component

This Academy includes several equipment demonstrations and hands-on lab sessions. Specific instrumentation suppliers have been selected for an instrumentation workshop on one evening. There is also a field trip to one of the OEM's noise and vibration facility in the metro Detroit area. Through these activities, you become acquainted with relevant instrumentation, measurement protocols, and problem solving strategies.

## LEARNING OBJECTIVES

By attending this academy, you will be able to:

- Define vehicle acoustics engineering terminology and principles
- Identify available acoustical materials and determine their optimum application
- Formulate a systematic approach to problem solving and measurement
- Conduct appropriate performance verification tests
- Analyze the contributing vehicle noise sources when devising noise solutions
- Produce valid measurements with noise instrumentation and accurately interpret results

## WHO SHOULD ATTEND

This academy will be especially valuable for engineers who address interior noise in the following types of vehicles:

- Passenger cars
- Light trucks
- Heavy trucks
- Off-highway vehicles
- Farm machinery
- Small planes
- Personal watercraft
- Rail transit vehicles

Gain practical experience with equipment demonstrations and hands-on lab sessions.

## CONTENT HIGHLIGHTS

- Sound Quality
- Vehicle Interior Noise-Related Topics
- Numerical Methods and Modeling
- Test Facilities and Measurements
- Numerical Acoustics
- Sound and Vibration Sensors
- Sound Level Meters and Analysis
- Source-Path-Receiver System
- Acoustical Materials and Test Methods
- Modal Analysis
- Component Measurements
- Instrumentation Workshop/  
Demonstrations
- Team Discussion
- OEM Facility Tour

## INSTRUCTOR

This academy has several expert instructors from industry. See the complete list of instructors on the course webpage.

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## I.D.# ACAD01

### SCHEDULE

October 2-6, 2017  
Troy, Michigan

### FEES

List: \$3,445

### Members

Classic: \$3,101

Premium: \$2,928

Elite: \$2,756

### FIVE-DAYS/4.0 CEUS

**Get more information and register:**  
[training.sae.org/academies/acad01/](http://training.sae.org/academies/acad01/)

# VEHICLE NOISE CONTROL ENGINEERING ACADEMY - POWERTRAIN NOISE TRACK



This Engineering Academy covers a variety of vehicle noise control engineering principles and practice. Two specialty tracks are available: Vehicle Interior Noise and Powertrain Noise. The Powertrain Noise track focuses on NVH issues generated by powertrain noise sources and the design strategies to minimize them. Noise sources include engines, transmissions/transfer cases, accessories, exhaust, gears, axles, joints, and couplings. Considerable attention is given to current measurement and instrumentation technologies and their effective use.

Gain practical experience with equipment demonstrations and hands-on lab sessions.

## Practical Component

This Academy includes several equipment demonstrations and hands-on lab sessions. Specific instrumentation suppliers have been selected to for an instrumentation workshop on one evening. There is also a field trip to one of the OEM's noise and vibration facility in the metro Detroit area. Through these activities, you become acquainted with relevant instrumentation, measurement protocols, and problem solving strategies.

## LEARNING OBJECTIVES

By attending this academy, you will be able to:

- Define vehicle acoustics engineering terminology and principles
- Articulate powertrain noise terminology and principles
- Formulate a systematic approach to problem solving and measurement
- Conduct appropriate performance verification tests
- Analyze the contributing vehicle noise sources when devising noise solutions
- Produce valid measurements with noise instrumentation and accurately interpret results

## WHO SHOULD ATTEND

This academy will be especially valuable for engineers who address powertrain noise in the following types of vehicles:

- Passenger cars
- Light trucks
- Heavy trucks
- Off-highway vehicles
- Farm machinery
- Small planes
- Personal watercraft
- Rail transit vehicles



## CONTENT HIGHLIGHTS

- Sound Quality
- Sound quality demonstration
- Engine NVH Mechanisms
- Powertrain & Driveline Noise Sources
- Powertrain Instrumentation Workshop
- Elastomer Properties and Tuned Mass Dampers
- Engine Mounting Systems
- Accessory Drive Noise and Vibration
- OEM Facility Tour
- NVH Signal Processing
- Diesel Engine Noise Sources and Control
- System Integration
- Instrumentation Workshop/Demo
- OEM Facility Tour
- Team Discussion

## INSTRUCTOR

This academy has several expert instructors from industry. See the complete list of instructors on the course webpage.

### I.D.# ACAD02

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### SCHEDULE

October 2-6, 2017  
Troy, Michigan

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### FEES

List: \$3,445

### Members

Classic: \$3,101

Premium: \$2,928

Elite: \$2,756

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### FIVE-DAYS/4.0 CEUS

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# INTRODUCTION TO CONTEMPORARY MUFFLER DESIGN TECHNIQUES



This seminar provides an introduction to the behavior of mufflers and silencers including a description of the two-port approach to muffler design. This seminar also covers the acoustic simulation of muffler and silencer systems and the use of experimental methods to measure muffler performance. Following a review of basic muffler concepts and definitions the course focuses on meeting design objectives such as insertion loss with a specific back pressure requirement. This course shows how modern software such as SIDLAB can be used to model both the acoustics and flow in achieving the design objective and the role that 1D engine simulations can play in providing important input. Finally, the instructors address optimizing muffler design to meet a specified design objective with a specified space constraint.

## LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Explain the underlying principles of mufflers and silencers
- Gain insight into muffler and silencer design concepts using contemporary software
- Understand experimental methods for measuring muffler and silencer performance

## WHO SHOULD ATTEND

This course is designed for engineers and technical managers seeking an understanding of the principles of muffler design and an introduction to the use of muffler and silencer design software.

## CONTENT HIGHLIGHTS

- Overview of Engine Exhaust and Intake Systems
- Engine Exhaust and Intake Systems Measurement Methods
- Design Approach for Exhaust and Intake Systems
- Software for Engine Exhaust and Intake Modeling Design

## INSTRUCTORS:

### Tamer Elnady

Associate Professor of Engineering,  
Ain Shams University

### Andrew F. Seybert

President of Spectronics, Inc.  
Professor Emeritus of Mechanical Engineering,  
University of Kentucky

Most muffler design in the automotive industry is accomplished by using “cut-and-try” methods that rely on what has worked in the past and/or extensive full-scale testing on engines for validation. New computer software aimed at muffler design can shorten the design cycle and yield more effective results.

## I.D.# C1352

### SCHEDULE

Upcoming dates are being scheduled. Check the course website for the most up-to-date information.

### FEES

List: \$315

### Members

Classic: \$284

Premium: \$268

Elite: \$252

### HALF-DAY/4 CEUS

**Get more information and register:**  
[training.sae.org/seminars/c1352/](http://training.sae.org/seminars/c1352/)

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# PRACTICAL NVH SIGNAL PROCESSING METHODS



This seminar will help you understand the foundation common to all NVH data acquisition equipment including digitizing, windows, aliasing, averaging techniques, and common analysis functions such as the power spectrum, transfer function and coherence. Fundamental concepts such as filtering, modulation, convolution, and correlation, as well as specialized techniques used in rotating machinery such as adaptive re-sampling and order tracking, will be covered. The seminar will also cover multi-input multi-output (MIMO) signal processing, array based solutions for force identification, source and path characterization and data visualization. Brief introductions to emerging concepts will also be explored and computer demonstrations, physical experiments and case studies will be used to illustrate applied, real-world problems.

## LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Explain the fundamental controls typical in modern spectrum analysis tools
- Interpret NVH data and judge its relevance to physical phenomena
- Extract new types of useful information from NVH data
- Implement new signal processing techniques

## WHO SHOULD ATTEND

NVH technicians, engineers and managers who want to understand how NVH data is produced and interpreted will find this seminar valuable. The material is presented at a level suitable for beginners, but offers the more experienced practitioners new insight into the concepts presented through the illustrations and demonstrations that are included.

## CONTENT HIGHLIGHTS

- Properties of the FFT
- Rotating Machinery Basics
- Time Frequency Methods
- Fundamentals of Multi-Input-Multi-Output (MIMO) System Analysis
- Forces and Sources in MIMO Systems
- Introduction to Data Classification and Pattern Recognition

## INSTRUCTORS:

### Michael F. Albright

Co-Founder and General Manager,  
Signal.X Technologies LLC

“The instructor is an expert! His knowledge and presentation skills are top notch.”

### Bryan Underwood

NVH Senior Project Engineer  
Detroit Diesel

## I.D.# C0431

### SCHEDULE

June 15-16, 2017

Grand Rapids, Michigan - *Held in conjunction with the SAE Noise and Vibration Conference*

### FEES

List: \$1,370

### Members

Classic: \$1,233

Premium: \$1,165

Elite: \$1,096

### TWO-DAYS/1.3 CEUS

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Enrich your professional development with these related noise, vibration, and harshness technology resources from SAE.

### BOOKS

#### **THE EVOLUTION OF AUTOMOTIVE TECHNOLOGY: A HANDBOOK**

This book covers one and a quarter century of the automobile, conceived as a cultural history of its technology, aimed at engineering students and all those who wish to have a concise introduction into the basics of automotive technology and its long-term development. Its approach is systemic and includes the behavior of drivers, producers, nonusers, victims, and other “stakeholders” as well as the discourse around mobility.

#### **BOSCH AUTOMOTIVE HANDBOOK, 9TH EDITION**

Experts trust the well-founded and extensive expertise that can be found in this global best-seller, now in its 9th English Edition. Researchers and engineers in the automotive industry (as well as engineering students) consult it. Mechanics who are studying to become master craftsmen also use it as a reference work. The newest edition has been completely revised and enhanced to include the most recent developments in automotive technology. About 200 specialist authors contributed to this new version of every engineer’s must-have reference.

#### **AUTOMOTIVE ENGINEERING FUNDAMENTALS**

From engines and transmissions to vehicle aerodynamics and computer modeling, the intelligent, interesting presentation of core concepts in Automotive Engineering Fundamentals is sure to make this an indispensable resource for engineering students and professionals alike.

### JOURNALS

#### **JOURNAL OF MATERIALS & MANUFACTURING: AN SAE SCHOLARLY JOURNAL**

Authoritative and in-depth research in materials, design, and manufacturing, with topics including new development, processes, modeling, simulation, analysis, integration, testing, optimization, practices, and methodologies.

## EVENTS

### SAE 2017 NOISE AND VIBRATION CONFERENCE AND EXHIBITION

June 12-15, 2017  
Grand Rapids, Michigan, USA

This is THE premier technical event dedicated to mobility noise, vibration and harshness. Held biennially, this conference serves as a forum for leading automotive, commercial vehicle, and aerospace professionals to share the latest technologies surrounding NVH, and sound quality. Topics covered include: Engine/Powertrain/Drivetrain; NVH Measurement; Standards, Process, and Perspectives; and Vehicle Subsystem NVH. Held in conjunction with INCE USA.

### SAE 2017 BRAKE COLLOQUIUM & EXHIBITION – 35TH ANNUAL

September 24-27, 2017  
Orlando, Florida, USA

Obtain the most critical and up-to-date information on braking and brake systems for OE/aftermarket customers and end users. By joining your peers for the 35th annual SAE Brake Colloquium & Exhibition, you will have the opportunity to participate in lively panel discussions, an unrivaled technical program, and a dynamic exhibition.

## STANDARDS

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# 2017 LIVE LEARNING SCHEDULE

for the complete and most up-to-date schedule visit  
[training.sae.org/calendar/](http://training.sae.org/calendar/)

## **Troy, MI, USA - SAE International Troy Office**

- Apr 19-21 Principles of Cost and Finance for Engineers – I.D.# C0828
- Apr 20 Introduction to Brake Noise, Vibration, and Harshness – I.D.# C1337
- Apr 20-21 Acquiring and Analyzing Data from Sensors and In-Vehicle Networks – I.D.# C0522
- Apr 21 Brake Noise Problem Resolution – I.D.# C0831
- Apr 24 Basic Tire Mechanics and Inspection – I.D.# C1423
- Apr 24-25 New! Cybersecurity: Introduction to Embedded System Exploitation – I.D.# C1524
- Apr 24-26 Hydraulic Brake Systems for Passenger Cars and Light Trucks – I.D.# C0509
- Apr 25-26 Tire Forensic Analysis – I.D.# C1424
- Apr 26-27 New! Cybersecurity: Software Assurance - Input Validation – I.D.# C1521
- Apr 27-28 Introduction to Brake Control Systems: ABS, TCS, and ESC – I.D.# C0315

## **Livonia, MI, USA - Effective Training Inc.**

- Apr 18-19 ISO Geometrical Tolerancing 2-day Workshop – I.D.# ETY510
- Apr 25-26 Fundamentals of GD&T 1994 2-day Workshop – I.D.# ETY120

## **Farmington, CT, USA - Homewood Suites by Hilton**

- Apr 18-19 New! AS9100:2016 Rev D: Transitioning to the New Requirements – I.D.# C1623

## **Troy, MI, USA - SAE International Troy Office—In conjunction with the WCX™17: SAE World Congress Experience**

- Apr 3-4 Design of Experiments (DOE) for Engineers – I.D.# C0406

## **Detroit, MI, USA - Cobo Center—In conjunction with the WCX™17: SAE World Congress Experience**

- Apr 3 Success Strategies for Women in Industry and Business – I.D.# C1202
- Apr 3 New! Cybersecurity: An Introduction for the Automotive Sector – I.D.# C1616
- Apr 3-4 New! Effective Writing for Engineering and Technical Professionals – I.D.# C1605
- Apr 3-4 Corrosion Engineering and Prevention – I.D.# C1217
- Apr 3-4 Evaporative and Refueling Emission Control – I.D.# C0928
- Apr 3-4 Advanced Diesel Particulate Filtration Systems – I.D.# C0502
- Apr 3-4 The Basics of Internal Combustion Engines – I.D.# C0103
- Apr 3-4 Engineering Project Management – I.D.# 99003
- Apr 3-4 Automotive Lighting: Design and Technology – I.D.# C0202
- Apr 3-4 New! Introduction to Active Safety Systems – I.D.# C1603
- Apr 3-5 Vehicle Dynamics for Passenger Cars and Light Trucks – I.D.# 99020
- Apr 3-5 Designing On-Board Diagnostics for Light and Medium Duty Emissions Control Systems – I.D.# C0707
- Apr 3-5 Weibull-Log Normal Analysis Workshop – I.D.# 86034
- Apr 4-6 Managing Engineering & Technical Professionals – I.D.# C0608
- Apr 5-6 Diesel Engine Technology – I.D.# 93014
- Apr 5-7 Fundamentals of Modern Vehicle Transmissions – I.D.# 99018
- Apr 5-7 Turbocharging Internal Combustion Engines – I.D.# C0314
- Apr 6 Automotive Lighting: Testing and Requirements – I.D.# C0618
- Apr 6-7 Engine Failure Investigation and Analysis – I.D.# C1344
- Apr 6-7 Product Liability and The Engineer – I.D.# 82001
- Apr 6-7 New! Fundamentals of Vehicle Suspension Design – I.D.# C1618
- Apr 7 Automotive Lighting: LED Applications – I.D.# C0727

**Live Online**

- Apr 11-13 Driver Distraction from Electronic Devices: Insights and Implications  
– I.D.# WB1140
- Apr 18-24 Catalytic NOx Control Technologies for Diesel and GDI Engines  
– I.D.# WB1237
- Apr 18-27 Root Cause Problem Solving: Methods and Tools – I.D.# WB0931
- Apr 19-26 Acoustic Fundamentals for Solving Noise and Vibration Problems  
– I.D.# WB1309

**Troy, MI, USA - SAE International Troy Office**

- May 1-3 Strategic Leadership – I.D.# C0620
- May 2-3 Introduction to Hybrid and Electric Vehicle Battery Systems – I.D.# C0626
- May 4 Safe Handling of High Voltage Battery Systems – I.D.# C1019
- May 4-5 Improving Fuel Efficiency with Engine Oils – I.D.# C0914
- May 8-9 Vehicle Frontal Crash Occupant Safety and CAE – I.D.# C0621
- May 8-9 Automotive Heat Transfer – I.D.# C1230
- May 11-12 Design Review Workshop – I.D.# C1306
- May 15-16 Introduction to Advanced High Strength Steel Applications and Manufacturing – I.D.# C1416
- May 15-17 Combustion and Emissions for Engineers – I.D.# 97011
- May 22-23 Powertrain Selection for Fuel Economy and Acceleration Performance  
– I.D.# C0243
- May 22-24 Internal Combustion Systems: HCCI, DoD, VCT/VVT, DI and VCR – I.D.# C0613

**Greer, SC, USA - BMW Performance Center**

- May 1-3 Applied Vehicle Dynamics – I.D.# C0414

**Livonia, MI, USA - Effective Training Inc.**

- May 23-24 Fundamentals of GD&T for Inspectors 2-day Workshop – I.D.# ETY125
- May 25-26 Advanced Concepts of GD&T 1994 - 2-day Workshop – I.D.# ETY210

**Cleveland, OH, USA - Ohio Aerospace Institute**

- May 8-9 ARP4754A and the Guidelines for Development of Civil Aircraft and Systems  
– I.D.# C1118
- May 11-12 ARP4761 and the Safety Assessment Process for Civil Airborne Systems  
– I.D.# C1245
- May 30-31 Introduction to DO-178C – I.D.# C1410

**Troy, MI, USA - SAE International Troy Office**

- May 15-19 Engineering Management Academy – I.D.# ACAD09

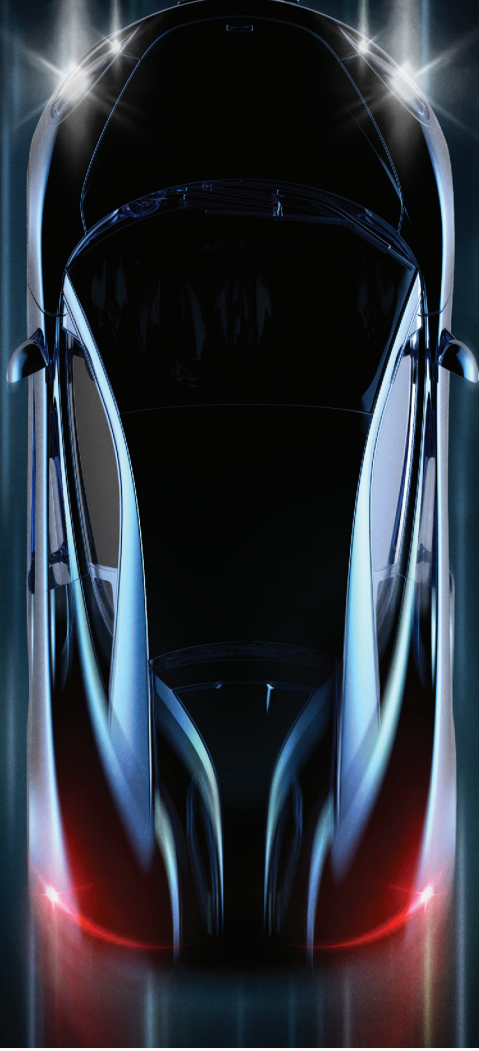
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- May 2-11 Principles of Electric Drives – I.D.# WB0941
- May 8-12 New! Keys to Creating a Cybersecurity Process from the J3061 Process Framework – I.D.# WB1604
- May 8-19 Finite Element Analysis (FEA) for Design Engineers – I.D.# WB1241
- May 16-25 Tolerance Stack-up Fundamentals – I.D.# C0842

**Troy, MI, USA - SAE International Troy Office**

- Jun 19-21 Advanced Vehicle Dynamics for Passenger Cars and Light Trucks  
– I.D.# C0415
- Jun 22-23 Variable Valve Actuation: Design and Performance Impact on Advanced Powertrains – I.D.# C1332
- Jun 26-27 Engineering Project Management – I.D.# 99003
- Jun 26-28 Motor Fuel: Technology, Performance, Testing, and Specifications  
– I.D.# 98003

# NOISE, VIBRATION AND HARSHNESS TECHNOLOGY EDUCATION & TRAINING GUIDE



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