SAE INTERNATIONAL®

WINTER ISSUE

NOISE, VIBRATION AND HARSHNESS TECHNOLOGY

EDUCATION & TRAINING GUIDE

January – December 2018

PLAN YOUR PROFESSIONAL DEVELOPMENT - 2018 OFFERINGS INCLUDED.

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

SAE multi-course certificates provide an outline of courses designed to extend your understanding in a specific technology area. When reviewing SAE education and training material, watch for the certificate icon. It indicates which courses are part of an SAE multi-course certificate program. For a list of programs, visit **training.sae.org/credentialing/certificate**.

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

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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 fnding 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 courses are available online anytime you wish to access the course through the internet

CERTIFICATE
This icon indicates that a 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 lab

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
March 23, 2018
Troy, Michigan

October 19, 2018
Palm Desert, California - *held in conjunction with the SAE 2018 Brake Colloquium & Exhibition*

FEES

List:	$810
Members	
Classic:	$729
Premium:	$689
Elite:	$648

ONE-DAY/.7 CEUS

Get more information and register: training.sae.org/seminars/c0831/

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training.sae.org/corplearning

INTRODUCTION TO BRAKE NOISE, VIBRATION, AND HARSHNESS

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

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.

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
March 22, 2018
Troy, Michigan

October 18, 2018
Palm Desert, California - *held in conjunction with the SAE 2018 Brake Colloquium & Exhibition*

FEES

List:	$810
Members	
Classic:	$729
Premium:	$689
Elite:	$648

ONE-DAY/.7 CEUS

Get more information and register:
training.sae.org/seminars/c1337/

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SAE'S "TOTAL" STEM SOLUTION

We are the only U.S.-based engineering organization to offer a full continuum of Kindergarten-College (K-16) science, technology, engineering, and math education opportunities. Learn how you can get involved at **saefoundation.org.**

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
March 6-13, 2018
Live Online

November 13-20, 2018
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/

ALSO AVAILABLE AS AN ON DEMAND COURSE

SAE Web Seminar RePlays are audio/visual captures of live web seminars. The course sessions are unedited and include the results of interactions between the instructor and participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

I.D.# PD331309ON

FEES
See above

6-HOURS/.6 CEUS

Get more information on this Web Seminar RePlay: training.sae.org/replays/pd331309on/

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
- Convergence of Frequencies
- Modal Analysis as a Tool to Find "Weak Spots"
- 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 11-22, 2018
Live Online

November 28-December 10, 2018
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/

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
May 10-11, 2018
Troy, Michigan

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/

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
January 10-19, 2018
Live Online

August 21-30, 2018
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/

ALSO AVAILABLE AS AN ON DEMAND COURSE

SAE Web Seminar RePlays are audio/visual captures of live web seminars. The course sessions are unedited and include the results of interactions between the instructor and participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

I.D.# PD331204ON

FEES
See above

8-HOURS/.8 CEUS

Get more information on this Web Seminar RePlay: 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 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
June 5-7, 2018
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/

ALSO AVAILABLE AS AN ON DEMAND COURSE

SAE Web Seminar RePlays are audio/visual captures of live web seminars. The course sessions are unedited and include the results of interactions between the instructor and participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

I.D. # PD331041ON

FEES
See above

4-HOURS/.4 CEUS

Get more information on this Web Seminar replay: 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
November 5, 2018
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/

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VEHICLE NOISE CONTROL ENGINEERING ACADEMY - VEHICLE INTERIOR NOISE

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

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

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.

I.D.# ACAD01

SCHEDULE
October 1-5, 2018
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/

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SAE members who have completed an SAE training in the last 12-months can get an additional 20% off of more courses if taken in the same 12-month period. Take a seminar in September; get 20% off two more seminars if taken by next September. Take a seminar in October; get 20% off of a seminar and an e-Seminar if taken by the next October. Some courses are not eligible.
Visit training.sae.org/discounts/ to view exclusions and conditions.

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+1.877.606.7323 (+1.724.776.4970 outside the U.S. & Canada). Please use promo code **FREQUENTPD** when registering.

VEHICLE NOISE CONTROL ENGINEERING ACADEMY - POWERTRAIN NOISE TRACK

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

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.

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
- 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

SCHEDULE
October 1-5, 2018
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/acad02/

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.

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.

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

I.D.# C1352

SCHEDULE
2018 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/

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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
March 12-13, 2018
Troy, Michigan

August 13-14, 2018
Troy, Michigan

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/c0431/

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BOOKS

VEHICLE NOISE, VIBRATION AND SOUND QUALITY

This book gives readers a working knowledge of vehicle vibration, noise, and sound quality. The knowledge it imparts can be applied to analyze real-world problems and devise solutions that reduce vibration, control noise, and improve sound quality in all vehicles—ground, aerospace, rail, and marine.

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.

CLEAN SNOWMOBILE CHALLENGE - 3: REFINEMENT OF PRODUCTION ENGINES AND NEW CONTROL STRATEGIES

This collection is a resource for studying the history of the evolving technologies that have contributed to snowmobiles becoming cleaner and quieter machines. Papers address design for a snowmobile using the EPA test procedure and standard for off-road vehicles, along with more stringent U.S. National Park Best Available Technology (BAT) standards that are likened to those of the California Air Resourced Board (CARB).

BRAKE NVH: TESTING AND MEASUREMENTS

This book provides readers with a fundamental understanding of current practices for measuring and testing brake NVH. From coverage of basic definitions and concepts to in-depth analysis of on-road testing procedures, it will serve as a comprehensive reference guide for brake test technicians, test engineers, lab managers, and others who work on making brakes quieter, smoother, more refined, and more reliable.

JOURNALS

SAE INTERNATIONAL JOURNAL OF MATERIALS & MANUFACTURING

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.

SAE INTERNATIONAL JOURNAL OF VEHICLE DYNAMICS, STABILITY, AND NVH

This SAE Scholarly Journal publishes peer-reviewed, original high-quality papers that address dynamics, stability, and NVH science and technologies of ground, marine, and aerospace vehicles. The editorial scope of the Journal covers all technical aspects of vehicle dynamics, stability, and NVH science and technologies.

EVENTS

SAE 2018 ADDITIVE MANUFACTURING IN MOTION SYMPOSIUM

March 13-14, 2018
Cleveland, Ohio, USA

This is THE premier additive manufacturing event for the mobility industry. Join us to hear from technical experts from both automobile and aerospace OEMs and Tier 1 and 2 suppliers, as well as those experts from government and academia with a forum to communicate needs, research, development activities, and solutions that will enable all stakeholders an opportunity to maximize the many benefits of this continually evolving technology.

WCX™: SAE WORLD CONGRESS EXPERIENCE

April 10-12, 2018
Detroit, Michigan, USA

At *WCX™: SAE World Congress Experience* practical meets potential. The premier talent in the automotive and mobility industry converge to address current challenges, discover new avenues of exploration, and explore the promise of the future of transportation engineering in an interactive experience.

STANDARDS

JPAKS

JPaks are online annual subscriptions that provide a cost-effective and convenient way to access the 2,000+ individual standards in SAE MOBILUS pertaining to ground vehicles. In addition, JPaks customers can now search and download any of the more than 2,600 historical versions of SAE Ground Vehicle Standards.

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2018 LIVE LEARNING SCHEDULE

For the complete and most up-to-date schedule visit training.sae.org/calendar.

JANUARY 2018

Live Online

Jan 10-19	New! Design for Additive Manufacturing: Towards End-Part Production – I.D.# WB1705
Jan 10-19	Vehicle Sound Package Materials – I.D.# WB1204
Jan 22-26	New! FEA Beyond Basics: Nonlinear Analysis – I.D.# WB1725
Jan 22-Feb 2	Design of Experiments (DOE) for Engineers – I.D.# WB0932

Kirkland, WA, USA - MicroTek - Seattle

Jan 30-31	Design Review Workshop – I.D.# C1306

FEBRUARY 2018

Troy, MI, USA - SAE International Troy Office

Feb 12-13	Control Systems Simplified – I.D.# C0525
Feb 21-22	New! Fundamentals of Vehicle Suspension Design – I.D.# C1618
Feb 28-Mar 1	A Familiarization of Drivetrain Components – I.D.# 98024

Live Online

Feb 5-9	New! FEA Beyond Basics: Thermal Analysis – I.D.# WB1726
Feb 19-Mar 7	Fundamentals of Geometric Dimensioning & Tolerancing (GD&T)

Livonia, MI, USA - Effective Training Inc. (ETI)

Feb 12-13	The Role of the Expert Witness in Product Liability Litigation – I.D.# 92054
Feb 13-15	Fundamentals of GD&T 2009 3-day – I.D.# ET1151

Durham, NC, USA - National Business Training (Raleigh)

Feb 12-13	The Basics of Internal Combustion Engines – I.D.# C0103

Herndon, VA, USA - MicroTek - Herndon (Dulles)

Feb 26-27	Introduction to Highly Automated Vehicles – I.D.# C1603

MARCH 2018

Troy, MI, USA - SAE International Troy Office

Mar 2	Fundamentals of Automotive All-Wheel Drive Systems – I.D.# C0305
Mar 12-13	Practical NVH Signal Processing Methods – I.D.# C0431
Mar 14-16	Fundamentals of Steering Systems – I.D.# C0716
Mar 19-21	Gasoline Direct Injection (GDI) Engines – I.D.# C1009
Mar 19-21	Advanced Vehicle Dynamics for Passenger Cars and Light Trucks – I.D.# C0415
Mar 22	Introduction to Brake Noise, Vibration, and Harshness – I.D.# C1337
Mar 22-23	Modern Fluids for Internal Combustion Engines: An Overview – I.D.# C0704
Mar 23	Brake Noise Problem Resolution – I.D.# C0831
Mar 26-27	Engine Failure Investigation and Analysis – I.D.# C1344
Mar 27-28	Diesel Engine Technology – I.D.# 93014

Live Online

Mar 6-13	Acoustic Fundamentals for Solving Noise and Vibration Problems – I.D.# WB1309
Mar 20-22	Introduction to Powertrain Calibration Engineering – I.D.# WB1346

Lombard, IL, USA - MicroTek - Chicago Metro

Mar 6-7	Introduction to Commercial and Off-Road Vehicle Cooling Airflow Systems – I.D.# C0738

Troy, MI, USA - SAE International Troy Office

Mar 19-23	New! Transmission Engineering Academy – I.D.# ACAD11

Troy, MI, USA - SAE International Troy Office

Mar 26	New! High Voltage Vehicle Safety Systems and PPE – I.D.# C1732
Mar 27-29	Hybrid and Electric Vehicle Systems – I.D.# C1504

Livonia, MI, USA - Effective Training Inc. (ETI)

Mar 13-15	Fundamentals of GD&T 1994 3-Day – I.D.# ET2001
Mar 20-21	Advanced Concepts of GD&T 1994 2-day – I.D.# ET2411
Mar 26	Fundamentals of Shielding Design for EMC Compliance – I.D.#C0835

Herndon, VA, USA - MicroTek - Herndon (Dulles)

Mar 19-21	Injuries, Anatomy, Biomechanics & Federal Regulation – I.D.# 85049

April 2018

Troy, MI, USA - SAE International Troy Office

Apr 3	Principled Negotiation – I.D.# C1602
Apr 4-6	Managing Engineering & Technical Professionals – I.D.# C0608
Apr 9-10	Fundamentals of Gear Design and Application – I.D.# C0223
Apr 16	Basic Tire Mechanics and Inspection – I.D.# C1423
Apr 17-18	Tire Forensic Analysis – I.D.# C1424
Apr 23-25	Hydraulic Brake Systems for Passenger Cars and Light Trucks – I.D.# C0509
Apr 30-May 2	Commercial Vehicle Braking Systems – I.D.# C0233
Apr 30-May 2	Strategic Leadership – I.D.# C0620

Troy, MI, USA - SAE International Troy Office—held in Conjunction with the WCX™: SAE World Congress Experience

Apr 9-11	Principles of Cost and Finance for Engineers – I.D.# C0828
Apr 12-13	Leading High Performance Teams – I.D.# C0410

Live Online

Apr 3-5	Driver Distraction from Electronic Devices: Insights and Implications – I.D.# WB1140
Apr 4-6	Patent Litigation in the U.S.: What You Need to Know – I.D.# WB0940
Apr 17-24	Catalytic NOx Control Technologies for Diesel and GDI Engines – I.D.# WB1237
Apr 17-May 1	New! Materials Degradation in Mechanical Design: Wear, Corrosion, Fatigue and their Interactions – I.D.# WB1722
Apr 18-27	Root Cause Problem Solving: Methods and Tools – I.D.# WB0931
Apr 25-27	New! Patent Litigation Risk Management Toolkit – I.D.# WB1525

Livonia, MI, USA - Effective Training Inc. (ETI)

Apr 10-11	Product Liability and The Engineer – I.D.# 82001
Apr 16-17	Fundamentals of GD&T for Inspectors 2-day – I.D.# ET2053
Apr 24-25	New! Critical Concepts of Tolerance Stacks – I.D.# ET1701

Appleton, WI, USA - FVTC Public Safety Training Center

Apr 30-May 3	Accessing and Interpreting Heavy Vehicle Event Data Recorders – I.D.# C1022

Pontiac, MI, USA - LHPU Campus

Apr 2-6	New! Gasoline Engine Calibration Engineering Academy – I.D.# ACAD10

El Segundo, CA, USA - MicroTek - El Segundo

Apr 23-25	New! Vehicle Crash Reconstruction: Principles and Technology – I.D.# C1728

Detroit, MI, USA - Cobo Center—held in Conjunction with the WCX™: SAE World Congress Experience

Apr 8	Brake Friction Materials: Testing, Quality and Selection – I.D.# C1020
Apr 8	Success Strategies for Women in Industry and Business – I.D.# C1202
Apr 9	Reconstruction and Analysis of Rollover Crashes of Light Vehicles – I.D.# C1502
Apr 9-10	Automotive Lighting: Design and Technology – I.D.# C0202
Apr 9-10	Introduction to Brake Control Systems: ABS, TCS, and ESC – I.D.# C0315
Apr 9-10	Engineering Project Management – I.D.# 99003
Apr 9-10	Introduction to Highly Automated Vehicles – I.D.# C1603
Apr 9-10	New! Fundamentals of Vehicle Suspension Design – I.D.# C1618

NOISE, VIBRATION AND HARSHNESS TECHNOLOGY
EDUCATION & TRAINING GUIDE

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