SUMMER ISSUE; VOL. 2

CHASSIS AND VEHICLE DYNAMICS TECHNOLOGY

EDUCATION & TRAINING GUIDE

August – December 2017

FEATURED COURSES

PLUS—Explore Related Chassis and Vehicle Dynamics Technology Resources on pages 36–37!

WHY SAE FOR PROFESSIONAL DEVELOPMENT?

Engineers and technical professionals in the ground vehicle and aerospace industries look to SAE as their trusted information resource and have done so for over 110 years. Get access to 300+ live online, in classroom, and on-demand learning programs. Programs in the technology areas shaping the automotive and aerospace industries. Courses designed to meet your specific needs with the right content to solve YOUR SPECIFIC CHALLENGES.

In this issue of the ***Chassis and Vehicle Dynamics Technology Education and 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 Chassis and Vehicle Dynamics Technology Resources on page 36! We've selected key SAE books, standards, journals, technical events, and other resources to further your professional development and deepen your technical knowledge.

EXPLORE THE FOLLOWING TOPICS IN THIS ISSUE OF THE CHASSIS AND VEHICLE DYNAMICS TECHNOLOGY EDUCATION & TRAINING RESOURCE GUIDE:

- Active Safety Systems
- Heavy Vehicle Handling
- Brakes and Braking Systems
- Suspension Systems
- Tire Mechanics

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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 complete list of programs, visit **training.sae.org/credentialing/certificate**.

WHY SAE? WHAT OUR CUSTOMERS ARE SAYING

"My overall understanding of vehicle dynamics has dramatically improved. I can now more confidently relate what I feel as a driver to what the vehicle is actually doing. Exactly what I came here for!"
(In reference to Applied Vehicle Dynamics - page 10)
Robin Warner
Systems Calibration Engineer - TRW Automotive

"This class strengthened the things I knew and opened the door to so many more ideas and concepts I hadn't been exposed to in the automotive industry."
(In reference to Advanced Vehicle Dynamics for Passenger Cars and Light Trucks - page 8)
Dan Santiso
Engineering - Steering Dynmics, Honda R& D Americas, Inc.

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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.

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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.

SAE CUSTOMER SERVICE

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CATALOG KEY

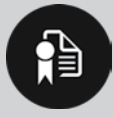
Look for the icons below included with the course descriptions. The icons indicate delivery formats for the course and whether the course is part of an SAE Certificate program.

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

ACTAR LOGO
This icon indicates the course is an ACTAR approved course. For more information on ACTAR and ACTAR accredited courses, visit training.sae.org/seminarsinfo/actar

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

TABLE OF CONTENTS

To help you better plan your training, we schedule live course offerings as far in advance as possible. The content in this resource guide reflects the most accurate information available at the time of publication. Rarely, unforeseen circumstances may force a change to the schedule. Early registration ensures that you not only have a spot in your selected course but are notified of any changes. For the most-up-to-date listing of scheduled courses, visit training.sae.org/calendar/. SAE International reserves the right to cancel offerings and cannot be held responsible for costs incurred beyond registration fees.

VEHICLE DYNAMICS CERTIFICATE PROGRAM

Designed to equip engineers with key vehicle dynamics and handling theory and application from a systems perspective, the objective of this program is for engineers to understand the interaction and performance balance between the major vehicle subsystems. The program design requires completion of fundamental and advanced-level vehicle dynamics theory and application courses with three elective courses that best suit an individual's interest areas or engineering emphasis.

The courses do not have to be taken in any specified order, although the Required Courses are good starting points if they can be scheduled and completed prior to the electives. The entire program must be completed within five years.

Successful completion of this multi-course certificate program equates to eight graduate credits towards the SAE/Kettering University 20-credit Certificate in Automotive Systems and Kettering's 40-credit M.S in Mechanical Engineering. Visit training.sae.org/credentialing/ceu/kettering_cp.htm for more information.

REQUIRED COURSES

- *Vehicle Dynamics for Passenger Cars and Light Trucks* Seminar or e-Seminar - see course description on page 20
- *Advanced Vehicle Dynamics for Passenger Cars and Light Trucks* Seminar - see course description on page 8

ELECTIVES INCLUDE:

- *Applied Vehicle Dynamics* Seminar - see course description on page 10
- *Hydraulic Brake Systems for Passenger Cars and Light Trucks* Seminar - see course description on page 27
- *Commercial Vehicle Braking Systems* Seminar - see course description on page 28
- *Introduction to Brake Control Systems: ABS, TCS, and ESC* Seminar or e-Seminar - see course description on page 30
- *High-Performance Brake Systems* Seminar - see course description online at: training.sae.org/seminars/c0718/

Courses no longer offered by SAE are still eligible if taken within the allowed time frame:

- *Fundamentals of Heavy Truck Dynamics* Seminar
- *Applied Heavy Duty Truck Dynamics* Seminar
- *Chassis and Suspension Component Design for Passenger Cars and Light Trucks* Seminar

Learn more about the Vehicle Dynamics Certificate Program and view the complete list of courses available. Visit training.sae.org/credentialing/certificate/vehicledynamics.htm

NEW! INTRODUCTION TO HIGHLY AUTOMATED VEHICLES

This course familiarizes you with the technologies enabling advanced driver assistance systems and how they integrate with existing passive occupant crash protection systems. Learn how ADAS functions perceive the world, make decisions, and either warn drivers or actively intervene in controlling the vehicle to avoid or mitigate crashes.

Every year, the U.S. experiences more than 32,000 traffic deaths and over 3.8 million crash injuries. While the trend in traffic deaths has been downward for the past decade, most of this reduction has been the result of optimizing passive occupant crash protection systems such as seatbelts and airbags.

LEARNING OBJECTIVES

By attending this seminar you will be able to:

- Explain the SAE Levels of Automation and where different ADAS functions fit in the hierarchy
- Explain the ADAS functions and articulate their limitations
- Identify different sensors used in advanced driver assistance systems, how they operate, and their limitations
- Analyze how different sensors can be combined to improve overall system performance
- Describe the current and future methodologies used in developing ADAS algorithms
- Articulate how ROC curves, DOE and Monte Carlo techniques can be used to measure and improve algorithm performance
- Critically examine the proposed federal rules and validation methods for advanced driver assistance systems
- Analyze how active safety systems may affect the performance of existing passive occupant safety systems and how integration of the systems might be accomplished
- Describe liability and policy considerations for OEM's and Tier suppliers

WHO SHOULD ATTEND

Anyone involved with vehicle safety performance or concerned with proposed NHTSA rulemaking; insurance industry analysts developing coverage standards for vehicles with active safety technologies.

CONTENT HIGHLIGHTS

- Role of Vehicle Automation in Reducing Traffic Fatalities
- Three Main Functions Provided by Highly Automated Vehicles (HAVs)
- Sensors Used in Highly Automated Vehicles
- Levels of Automation
  - BASt; NHTSA
  - SAE - Prior to September 2016 & September 2016 Operational Driving Domain revision
  - Comparison of the Three Versions
  - Level 3 Handoff Problem

- Operation / Functionality of Various HAV Capabilities, including:
  - Blind spot warning / Do not pass warning / Left turn assist
  - Backup assist / cross traffic warning
  - Lane departure warning; Lane keep assist
  - Cruise control/Adaptive cruise control
  - Forward collision warning; Collision imminent steering
  - Automatic emergency braking
  - Pedestrian detection
  - Auto park / park assist
  - Platooning
- SAE Level of Automation in Each Application
- Advantages and Limitations of Each Capability
- Sensor(s) used in Each Capability
- Technology Spread, Effects on Insurance Claims
- Sensors – Passive and Active
  - GPS; GLONASS; IMU; Gyros; Cameras; Ultrasonic; Radar; Lidar; Leddar; Matrix TOF camera; DSRC
  - Limitations of Sensors Used in HAV Capabilities
  - Sensor Performance; Sensor Recalls
- Algorithms: types; examples; Using ROC Analysis to Measure Algorithm Performance
- Testing Used in Development of Systems; Strengths & Weaknesses
- Basic Network Architecture of a Modern Vehicle
- Probable Attack Surfaces & Their Vulnerabilities
- OBD II Vulnerabilities
- Possible Defenses Against Attacks
- NHTSA October 2016 Best Practices Guidance
- Ethical Challenges
  - Differences Between Human and Autonomous Crash Decision Making
  - Rational Decision-making Approaches; Deontology and Consequentialism
  - Artificial Intelligence Approach - Strengths and Weaknesses
- Liability
- Regulations
- HAV Implications for Passive Safety
- HAV Public / Industry Misconceptions

INSTRUCTOR

Jeffery Blackburn
North American Sales Manager, Tass International

I.D.# C1603

SCHEDULE
November 8-9, 2017
Troy, Michigan

December 7-8, 2017
Shanghai, China

FEES

List	$1,370
Members	
Classic	$1,233
Premium	$1,165
Elite	$1,096

TWO-DAYS/1.3 CEUS

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NEW! FUNDAMENTALS OF VEHICLE SUSPENSION DESIGN

Suspension component design continues to move toward mass and cost efficient designs with high levels of stiffness being essential to achieving design requirements. Mass, cost and stiffness are expected to become increasingly important with higher fuel economy requirements, alternative energy sources and the move to autonomous vehicles. This course emphasizes the basic tenets of suspension design enabling strategically important product trends.

This seminar will be helpful to individuals interested in enrolling in other SAE seminars such as *Vehicle Dynamics for Passenger Cars and Light Trucks* (page 20), or *Advanced Vehicle Dynamics for Passenger Cars and Light Trucks* (page 8)

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Discuss the basic attributes of suspension design
- Evaluate various suspension types, identifying advantages and tradeoffs
- Convey an understanding of vehicle level boundary conditions for suspension geometry
- Analyze suspension designs and how they affect vehicle performance
- Assess the basics of ground lines and tire envelopes on vehicle design

WHO SHOULD ATTEND

This seminar is designed for automotive engineers with a need to understand the basics of suspension design as well as suspension integration into the vehicle environment. The course is intended for both OEM and Supplier Engineers working in applications, materials, product design, development, testing, simulation and/or research.

CONTENT HIGHLIGHTS

- Suspension's role in the vehicle
- Front and rear suspension types
- Vehicle packaging
- Suspension geometry and alignment
- Tire envelopes and ground lines
- Vehicle dyanmics and NVH

INSTRUCTOR

William Pinch
Industry Consultant

The design and development of vehicle suspensions significantly influences vehicle handling and ride comfort. Suspension geometry is the foundation of vehicle performance from which high-confidence suspension components and tunings can be developed.

I.D.# C1618

SCHEDULE
August 21-22, 2017
Troy, Michigan

December 4-5, 2017
Troy, Michigan

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

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P151640

ADVANCED VEHICLE DYNAMICS FOR PASSENGER CARS AND LIGHT TRUCKS

Governing state-space equations with transfer functions for primary ride and open loop handling will be developed & analyzed. Building on the analysis of the state space equations, common physical tests and their corresponding CAE solutions for steady state and transient vehicle events will be presented. The "state-of-the-art" of vehicle dynamics CAE will be discussed. Common lab and vehicle tests and corresponding metrics used to assess chassis system and vehicle performance will be discussed in great detail. Hands-on workshops using CARSIM™ vehicle dynamics simulation software will help reinforce the material. Significant time will also be dedicated to the use of design of experiments (DOE) as a tool to assist in the analysis and optimization of chassis systems for multiple vehicle responses.

"This class strengthened the things I knew and opened the door to so many more ideas and concepts I hadn't been exposed to in the automotive industry."

Dan Santiso
Engineering – Steering Dynamics
Honda R&D Americas, Inc

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Apply vehicle dynamics theory to practical evaluation and measurement
- Use governing state space equations and transfer functions to determine the effect of key parameters on primary ride and open loop handling
- Describe the current "state-of-the-art" of vehicle dynamics CAE
- Articulate various types of vehicle dynamics models
- Recognize kinematics and compliance (K&C) lab tests commonly used to quantify chassis system performance
- Identify and evaluate important K&C metrics used in vehicle dynamics development
- Identify and utilize important vehicle tests commonly used in industry to evaluate ride, steering and handling performance
- Relate chassis system characteristics to vehicle dynamic performance
- Utilize vehicle dynamics CAE software for the simulation of common physical lab and vehicle tests
- Apply design-of-experiments (DOE) to vehicle dynamics development

WHO SHOULD ATTEND

This seminar is designed for automotive engineers in the vehicle dynamics, chassis, suspension, steering and braking fields who work in product design, development, testing, simulation or research.

CONTENT HIGHLIGHTS

- Modeling Primary Ride Dynamics
- Modeling Vehicle Handling Dynamics
- Introduction to Vehicle Dynamics CAE
- Measurement and Simulation of Suspension Kinematics and Compliance (K&C)
- Measurement and Simulation of Primary Ride
- Measurement and Simulation of Acceleration and Braking
- Measurement and Simulation of Steering
- Measurement and Simulation of Open Loop Handling
- Measurement and Simulation of Closed Loop Handling
- Design of Experiments (DOE) Applied to Vehicle Dynamics Development
- CarSim™ Exercises--Primary Ride Simulation, Steering, Open Loop Handling, Closed Loop Handling, Primary Ride

INSTRUCTORS

Dr. Richard Lundstrom
Independent Research and Project Engineer

Timothy Drotar
Product Development Engineer, Ford Motor Company

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I.D.# C0415

SCHEDULE
October 25-27, 2017
Troy, Michigan

FEES

List:	$1,745
Members	
Classic:	$1,571
Premium:	$1,483
Elite:	$1,396

THREE-DAYS/2.0 CEUS

Get more information and register:
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APPLIED VEHICLE DYNAMICS

While a variety of new engineering tools are becoming available to assist in creating optimal vehicle designs, subjective evaluation of vehicle behavior is still a vital tool to ensure desired braking, handling, and other dynamic response characteristics. In order to better prepare you for this task, this course offers study devoted to the key fundamental principles associated with longitudinal and lateral vehicle dynamics. Each classroom session is paired with an on-track exercise to immediately reinforce concepts with a dedicated behind-the-wheel driving session, effectively illustrating these principles in the real world.

Exercises build the bridge between vehicle dynamics theory and practical application by providing a rich academic underpinning and then reinforcing it with highly focused and relevant driving experiences. Significant technical skill-building is provided, with increased instructor supervised track time to further absorb the principles learned on days one and two. If your job description does require performance driving skills, the dynamic exercises on day three will lay a solid foundation on which you can independently refine your own skills.

"You will never have a full understanding of vehicle dynamics without this course as a base. While the screeching tires and smoke add to the effect, the experience "sticks" in your head."

Shad Tisdale
Research Engineer - Tire Mechanics
Cooper Tire & Rubber Company

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Explain tire-road friction limits and compose the friction circle for a given vehicle system
- Compute fundamental braking response attributes
- Illustrate the physics of turning and calculate lateral weight transfer
- Estimate brake system balance and brake proportioning
- Measure and graph a vehicle's understeer gradient
- Analyze basic anti-lock brake system (ABS) operation
- Discuss the effectiveness and limitations of electronic stability control (ESC) systems
- Calculate the most efficient path for a vehicle to negotiate a given test maneuver
- Comprehend the subtle effects that vehicle positioning has on vehicle speed
- Predict what response characteristics can be influenced by vehicle state
- Define those vehicle dynamic attributes which can be impacted through vehicle selection

WHO SHOULD ATTEND

This course has been developed for engineers and technical personnel involved in all fields related to the design or development of vehicle dynamics, vehicle braking systems, powertrain systems, chassis systems, or suspension systems. In addition, this course is valuable to those with component design responsibilities in brake, chassis, suspension, or tire disciplines who desire a fundamental background in vehicle dynamics with a practical driving linkage.

CONTENT HIGHLIGHTS

- Longitudinal Slip and Weight Transfer
- Fundamentals of Straight-Line Braking
- Slip Angle and Transient Response
- Braking Stability
- Steady-State Cornering
- Combining Lateral and Longitudinal Slip
- Anti-Lock Brake Systems
- Electronic Stability Control
- Test Procedure Selection
- Test Procedure Sensitivity
- Test Vehicle Sensitivity
- Comparison Vehicle Evaluation
- Driving Exercises--brake in a turn; skidpad; avoidance; wet skidpad; path selection; path variation; low pressure; lapping

INSTRUCTOR

James Walker, Jr.
Principal Engineer, Carr Engineering, Inc.

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I.D.# C0414

SCHEDULE
October 9-11, 2017
Greer, South Carolina

FEES

List:	$2,845
Members	
Classic:	$2,561
Premium:	$2,418
Elite:	$2,276

THREE-DAYS/2.4 CEUS

Get more information and register:
training.sae.org/seminars/c0414/

BASIC TIRE MECHANICS AND INSPECTION

This course provides an introduction to basic tire mechanics, including materials, sidewall stampings, pressure, tread patterns, tire inspection and basic tire failure identification of passenger and light truck tires. Practical in nature and supplemented with samples and hands-on activities, the course will provide you with information that you can use immediately on-the-job and apply to your own vehicle. It serves as a good primer for the in-depth SAE *Tire Forensic Analysis* course.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Read the sidewall of a tire and explain all of the nomenclature
- Describe the various types of tread patterns and what they mean on a tire
- Describe what is inside the tire and how that relates to some of the sidewall stampings
- Photograph black objects and quickly inspect tires in the field
- Visualize and explain basic tire failures

WHO SHOULD ATTEND

This course is extremely helpful for Accident Reconstructionist, Law Enforcement and those with a thirst for knowledge on tires. The materials are basic in nature and not intended for individuals with substantial tire knowledge and is not intended to teach tire design.

CONTENT HIGHLIGHTS

- Tire Size
- Sidewall Stamping
- Inflation Pressure
- Load and Reserve Load
- Tire Terminology
- Tire Construction
- Tire Types and Tread Patterns
- Inspection and Photography in the Field
- Basic Failure Mode Identification

INSTRUCTOR

Thomas Giapponi
Industry Consultant

Practical in nature and supplemented with samples and hands-on activities, the course will provide you with information that you can use immediately on-the-job and apply to your own vehicle.

I.D.# C1423

SCHEDULE
Upcoming dates are being scheduled for this course. Please check the course web page for the most up-to-date information.

FEES

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

ONE-DAY/.7 CEUS

Get more information and register: training.sae.org/seminars/c1423/

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P1776191

FUNDAMENTALS OF STEERING SYSTEMS

Design and development of a modern steering system influences vehicle response, driver controllability, comfort, safety and fuel economy. In this interactive seminar, participants will analyze the steering system, from the steering wheel to the road wheel. The seminar will cover the anatomy and architecture of the lower steering system (wheel end suspension geometry, linkages and steering gear), its effect on vehicle response, and how a force at the contact patch is translated to a torque in the steering wheel. The anatomy and architecture of the upper steering system (steering column and intermediate shaft), including the topic of non-uniformity and the role of the upper steering in the occupant protection system will also be explored.

Significant time will be devoted to the generation of power assist, either by way of a conventional hydraulic power steering (HPS) or electrically power assisted steering (EPAS). Topics include system anatomy/architecture as well as the effect of the system on fuel economy. The seminar will finish with a discussion of common steering objective tests and how the kinematics, compliances, friction and power assist affect steering response and torque feedback. Students will have the opportunity to participate in exercises throughout the seminar, culminating in a final project where they will calculate an assist curve for both a HPS and an EPAS system.

"Tim provides a very thorough overview of common steering systems in a practical, easy to understand, hands on manner."

Phil Kling
Manager, Product Investigations
General Motors of Canada LTD.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Identify common steering and suspension system architectures
- Compare and contrast different types of steering gears
- Describe the function of the steering column and intermediate shaft subsystem
- Describe the influence of system tuning on steering response and torque feedback
- Compare and contrast different types of power assist systems
- Describe the effect of power steering on fuel economy
- Calculate important parameters that affect steering response and torque feedback
- Describe some of the features of advanced steering systems

WHO SHOULD ATTEND

Automotive engineers in the vehicle dynamics, chassis, suspension, steering and chassis controls fields who work in product design, development, testing, simulation or research.

CONTENT HIGHLIGHTS

- Introduction—elements of the steering system; coordinate systems
- The Lower Steering System
  - Kingpin axis
  - Linkages/steering geometry
  - Steering gear anatomy
- The Upper Steering System (steering column & intermediate shaft)
  - Anatomy & architecture
  - Non-uniformity
  - Role of the upper steering system in occupant protection system
- Power Assist Systems
  - Hydraulic power assist
  - Electro-hydraulic assist
  - Electric power assisted systems
- Effect of steering system design on vehicle level performance
  - Low-speed and high-speed
  - Error states
- Advanced Steering Systems
  - Driver assistance features
- Classroom exercises

INSTRUCTOR

Timothy Drotar
Senior Research Engineer,
Ford Motor Company

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• Or, opt into the volunteer pool to be matched with options based on criteria you provide; you'll also receive alerts on future openings

I.D.# C0716

SCHEDULE
September 18-20, 2017
Troy, Michigan

FEES

List:	$1,745
Members	
Classic:	$1,571
Premium:	$1,483
Elite:	$1,396

THREE-DAYS/2.0 CEUS

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THE TIRE AS A VEHICLE COMPONENT

The principal functions of the pneumatic tire are to generate driving, braking, and cornering forces while safely carrying the vehicle load and providing adequate levels of ride comfort. This seminar explains how tire forces and moments are generated under different operating and service conditions and, in turn, demonstrates how these forces and moments influence various vehicle responses such as braking, handling, ride, and high-speed performance. The content focuses on the fundamentals of tire behavior in automobiles, trucks, and farm tractors, but also includes experimental and empirical results, when necessary.

The Pneumatic Tire, a 700-page E-book on CD, edited by Dr. Joseph Walter and Alan Gent is included in the course material.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Explain the force and moment generating behavior of tires as related to construction, materials, and operating conditions
- Predict vehicle response based on tire characteristics using basic laws of mechanics supplemented by experimental results as necessary

WHO SHOULD ATTEND

This course is designed principally for technical professionals in the automobile, tire, and wheel industries and their suppliers. In addition, some case studies and examples involve truck, agriculture, and aircraft tires.

CONTENT HIGHLIGHTS

- Longitudinal Tire Properties
- Lateral Tire Properties
- Combined Longitudinal and Lateral Forces
- The Tire as a Spring
- Tire and Wheel Non-Uniformities
- Influences of Tire Properties on Vehicle Response
- Future Technological Developments

INSTRUCTOR

Dr. Joseph D. Walter
Adjunct Professor, College of Engineering, University of Akron

"Relevant introduction to the importance of tire properties as it relates to vehicle dynamics and performance."

David Klyde
Principal Research Engineer
Systems Technology, Inc.

I.D.# C0101

SCHEDULE
September 28, 2017
Orlando, Florida
Held in conjunction with the SAE 2017 Brake Colloquium

FFEES

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

ONE-DAY/.7 CEUS

Get more information and register: training.sae.org/seminars/c0101/

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P1769672

TIRE AND WHEEL SAFETY ISSUES

One of the most important safety critical components on cars, trucks, and aircraft is the pneumatic tire. Vehicle tires primarily control stopping distances on wet and dry roads or runways and strongly influence over-steer/under-steer behavior in handling maneuvers of cars and trucks. The inflated tire-wheel assembly also acts as a pressure vessel that releases a large amount of energy when catastrophically deflated. The tire can also serve as a fulcrum, both directly and indirectly, in contributing to vehicle rollover. This seminar covers these facets of tire safety phenomena. Engineering fundamentals are discussed and illustrated with numerous practical examples and case studies of current public interest.

The Pneumatic Tire, a 700-page E-book on CD, edited by Dr. Joseph Walter and Alan Gent is included in the course material.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe the most important performance parameters and operating conditions of pneumatic tires related to safety
- Use fundamental equations of engineering science to predict and/or explain tire-vehicle interactions related to safety

WHO SHOULD ATTEND

This course is designed principally for technical professionals in the automobile, tire, and wheel industries and their suppliers. In addition, some case studies and examples involve truck, agriculture, and aircraft tires.

CONTENT HIGHLIGHTS

- Vehicle accident statistics
- Role of the tire in accident prevention/causation
- Construction features
- Failure Modes
- Tire Grip and Related Phenomena
- Brake Performance
- The Tire as a Pressure Vessel
- Over-steering Vehicles
- Vehicle Rollover Analysis

INSTRUCTOR

Dr. Joseph D. Walter
Adjunct Professor, College of Engineering, University of Akron

"It has a great technical content as well as a very interesting historical background."

Gerardo Andrade
OE Quality Manager
Pirelli Tire

I.D.# C0102

SCHEDULE
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/c0102/

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P151640

VEHICLE DYNAMICS FOR PASSENGER CARS AND LIGHT TRUCKS

This seminar will present an introduction to Vehicle Dynamics from a vehicle system perspective. The theory and applications are associated with the interaction and performance balance between the powertrain, brakes, steering, suspensions, and wheel and tire vehicle subsystems. The role that vehicle dynamics can and should play in effective automotive chassis development and the information and technology flow from vehicle system to subsystem to piece-part is integrated into the presentation. Governing equations of motion are developed and solved for both steady and transient conditions. Manual and computer techniques for analysis and evaluation are presented. Vehicle system dynamic performance in the areas of drive-off, braking, directional control and rollover is emphasized. The dynamics of the powertrain, brakes, steering, suspension, and wheel and tire subsystems and their interactions are examined along with the important role of structure and structural parameters related to vehicle dynamics. Physical experiments, applicable to vehicle dynamics are also introduced. Attendees will receive the *Bosch Automotive Handbook* and *The Automotive Chassis: Engineering Principles* by Reimpell, Stoll and Betzler.

"The Instructor and seminar content were excellent! He kept it interesting and encouraged class participation. Well worth three days of my time!"

Angela Amerson
Global Product Validation Manager
General Motors

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Summarize how vehicle dynamics is related to the voice of the customer
- Identify important vehicle system parameters useful for effective application of vehicle dynamics to chassis development
- List and explain parameters that effect vehicle performance relative to drive-off, braking, directional control and rollover
- Identify physical measurements needed to effectively apply vehicle dynamics to passenger cars and light trucks
- Define the value of vehicle dynamics simulation in the development and evaluation of vehicles
- Explain the balance required between ride, directional control and rollover and the essential process for this balance to be obtained for marketplace vehicles

WHO SHOULD ATTEND

Automotive engineers and quality professionals who work in product design, testing, quality, process or development will benefit from attending.

CONTENT HIGHLIGHTS

- The Role of Vehicle Dynamics in Passenger Car and Light Truck Product Development
- Vehicle Dynamics and the Voice of the Customer
- Effective Metrics for Vehicle Dynamics
- Tire Fundamentals: Tire Wheel System Anatomy and Architecture, Tire Axis System, Parameters and Characteristics
- Elementary Tire Patch Forces and Moments: Forces and Moments at the Tire Contact Patch During Steady Braking, Steady Cornering and Steady Drive-Off Maneuvers
- Acceleration (Drive-Off) Performance
- Braking Performance
- Ride Fundamentals
- Cornering Fundamentals
- Suspension Systems
- Steering Systems
- Roll-Over Fundamentals
- Introduction to CAE Applications for Vehicle Dynamics

INSTRUCTOR

Richard Lundstrom
Independent Research and Project Engineer

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 device with internet access. We are also proud to offer on demand courses from partner organizations like Ford, CALISO, and Industrial Metallurgists, LLC.

I.D.# 99020

SCHEDULE
December 6-8, 2017
Troy, Michigan

FEES

List:	$1,975
Members	
Classic:	$1,778
Premium:	$1,679
Elite:	$1,580

THREE-DAYS/2.0 CEUS

Get more information and register:
training.sae.org/seminars/99020/

ALSO AVAILABLE AS AN ON DEMAND COURSE.
Convenient, portable, and with core content from the instructor-led seminar, this fifteen hour e-Seminar option offers an alternative way to receive the same instruction without the expense of travel and time away from the workplace. This course offers instruction and simulations divided into nineteen video modules and includes the same resources and handouts as the classroom option.

I.D. # PD130702ON

FEES

List:	$695
Members	
Classic:	$626
Premium:	$591
Elite:	$556

15-HOURS/ 1.5 CEU

View the complete course description and a video demo:
training.sae.org/eseminars/pd130702on/

TIRE FORENSIC ANALYSIS

This course provides a detailed description of tire failure modes, their potential causes, identification, and the sometimes subtle nuances that go along with determination of tire failure. In addition, proper inspection techniques of tires will be discussed and samples will be available to reinforce the concepts learned.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Explain the methodologies of good tire inspection
- Describe tire failure causes
- Identify and determine root causes of tire failure

WHO SHOULD ATTEND

This course is extremely helpful for Accident Reconstructionists, Law Enforcement, Warranty investigators and individuals who need to be able to explore and explain tire failures.

PREREQUISITES

Individuals should already possess a basic knowledge of tires gained through work experience or through classes such as SAE's Basic Tire Mechanics course.

CONTENT HIGHLIGHTS

- Belt Separation - Tread/Belt Detached & Belt Intact
- Belt Separation Locations and rate of growth
- Identification of Causes and Contributors to Belt Separation
- Overlaying and Time
- Impact
- Ozone Deterioration
- Mounting / Demounting Damage
- Physiological Damage
- Snags, Gouges, Cuts, Tears, Abrasions
- Cutting and Chipping (C&C)
- Poor Tire Storage
- Vehicle Caused Conditions
- Non-Belt Separation Types
- Runflats
- Liner Conditions
- Wheel Conditions
- Tire Location on the Vehicle
- Brassy Wire Failure
- Manufacturing Imprints
- Overlays
- Tire Examination

INSTRUCTOR

Thomas Giapponi
Industry Consultant

"Mr. Giapponi holds a great wealth of tire knowledge. I learned a great deal from his course."

Caleb R. Williams
Mechanical Engineer
Wolf Technical Services, Inc.

I.D.# C1424

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

FEES

List:	$1,450
Members	
Classic:	$1,305
Premium:	$1,233
Elite:	$1,160

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/c1424/

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BRAKE FRICTION MATERIALS: TESTING, QUALITY AND SELECTION

This seminar will provide an introduction to brake lining raw materials and formulation, manufacturing, quality control and testing. The course covers the critical elements that must be reviewed before arriving at a lining selection decision. Different classes of friction material and their use are defined.

The choice of brake friction materials varies per application, but each must have the appropriate coefficient of friction and be able to disperse large amounts of heat without adversely effecting braking performance.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe the principles of friction
- Define the basic elements of friction material formulations
- Identify the difference between OE and after-market friction materials
- Identify appropriate tests to distinguish the differences between friction materials
- Interpret friction material test results

WHO SHOULD ATTEND

Engineers and technicians working for friction material manufacturers and suppliers to friction material industries will find this course valuable. Brake system designers, quality control auditors, product development engineers, application engineers, lab/bench/vehicle test technicians, managers/friction material sales and marketing will all gain valuable insight into this highly guarded industry.

CONTENT HIGHLIGHTS

- Principles of Friction Materials
- Lining Coefficient of Friction
- Formulation/Compounding Friction Material
- Manufacturing Friction Material
- General Asbestos/Non-asbestos Friction Material Characteristics
- Friction Material Testing
- Edge Code
- Bench & Vehicle Tests
- Wheel Dust Test
- Government Regulations
- OE and After-market Friction Material Lining Selection
- Issues Facing Friction Material Industries
  - Copper in brake pads
  - CA intended regulations
- Workshop

INSTRUCTOR

Mohammad Vakili
Industry Consultant

I.D.# C1020

SCHEDULE
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/.65 CEUS

Get more information and register: training.sae.org/seminars/c1020/

NEW! ADAS APPLICATION: AUTOMATIC EMERGENCY BRAKING

This one-day course is designed to provide an overview of the typical ADAS AEB system from multiple perspectives. A technical overview of the development cycle processes specific to AEB, including system level requirements and design architecture will be presented as well as design considerations for AEB from a functional safety (ISO-26262) perspective. A general overview of algorithm concepts for the various AEB subsystems will be demonstrated followed by a review of AEB system test and validation methods. Finally, discussion is facilitated toward understanding customer perception and acceptance of AEB at present. The participant should obtain a fundamental understanding of design principles and functional composition for a typical AEB system.

Active Safety, Advanced Driver Assistance Systems (ADAS) are now being introduced to the marketplace as they serve as key enablers for anticipated autonomous driving systems. Automatic Emergency Braking (AEB) is one ADAS application which is either in the marketplace presently or under development as nearly all automakers have pledged to offer this technology by the year 2022.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe AEB features / functionality as provided by most OEMs, including the capabilities and limitations of typical AEB systems
- Identify key principles of vehicle dynamics and system engineering disciplines which are integral to AEB system development
- Describe the general activities required for driving and braking tasks and comment on how these form the bases for AEB system requirements
- Identify AEB system architectures and subsystem composition and describe the function and purpose of each subcomponent
- Identify functional safety (ISO-26262) implications specific to AEB including review of basic hazard and risk analysis examples
- Explain algorithm concepts and functions for each of the AEB subsystems
- Critically examine various methods and levels of testing specific to AEB
- Describe the current state of AEB development from a consumer perspective

WHO SHOULD ATTEND

This course is designed for engineers and managers within related professions who are looking for an in-depth technical overview of Automatic Emergency Braking systems.

CONTENT HIGHLIGHTS

- Automatic Emergency Braking Overview
  - History: active safety origins
  - Key enablers for Automatic Emergency Braking (AEB)
  - AEB level of automation
  - AEB features and marketed benefits
- Primer: Basic Engineering Fundamentals
  - Vehicle dynamics; Wheel dynamics
  - System engineering requirements flow down
- AEB System Requirements
  - Basic driving tasks; Basic braking tasks
  - General & refined system requirements
- AEB System Architecture and Decomposition
  - Functional Architecture – sensing systems, warning systems, actuation systems
  - AEB operation modes
  - Physical Architecture – sensors, adaptive cruise control (ACC) ECU, body control module (BCM) ECU, electronic stability control (ESC) ECU
- AEB System Design: Safety
  - ISO-26262 framework
  - Hazard analysis and risk assessment exercise
  - AEB safety goals and requirements
  - Safety of the intended function (SOTIF) considerations
- AEB System Design: Performance Objectives
  - Sensing technology and implementation
  - Computational objectives: AEB ECU computing platforms
  - Human Machine Interface (HMI) warnings and considerations
  - Actuator objectives: braking actuator control design
- AEB System Test and Validation
  - AEB validation objectives
  - Subsystem testing
  - Vehicle level testing
- Conclusions and Future Direction
  - Market penetration
  - Customer acceptance
  - Incremental steps towards full autonomy

INSTRUCTOR

Eldon Leaphart
Principal Engineer, Carr Engineering, Inc.

I.D.# C1704

SCHEDULE
November 10, 2017
Troy, Michigan

FEES

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

ONE-DAY/.7 CEUS

Get more information and register at: training.sae.org/seminars/c1704/

BRAKE NOISE PROBLEM RESOLUTION

Brake noise is one of the highest ranked complaints of car owners. Grunts, groans, squeaks, and squeals are common descriptions of the annoying problem which brake engineers spend many hours trying to resolve. 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

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
  - Frequency range
  - Source/path/receiver
- Principles and Applications of Brake Shims
  - Damping
  - Role and purpose of brake shims
  - Different types of brake shims
  - Brake shims damping mechanisms
- Tools for Brake Noise Analysis/Reduction
  - Brake noise categorization
  - Solution strategy
  - Investigative tools -- Testing; Simulation
- Squeal
  - Brake pad design optimization
  - Pressure distribution optimization
  - Low frequency squeal
- Moan/Groan
  - After-stop noise program -- Problem identification; Transmission of the road to the lab; Measurement systems; Root cause analysis; Solution

INSTRUCTOR

Eric Denys
Vice President of Global OE Brake and AM Integration, Wolverine Advanced Materials

This seminar 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.

I.D.# C0831

SCHEDULE
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/

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HYDRAULIC BRAKE SYSTEMS FOR PASSENGER CARS AND LIGHT TRUCKS

This course analyzes automotive braking from a system's perspective, emphasizing legal requirements as well as performance expectations. Calculations necessary to predict brake balance and key system sizing variables that contribute to performance will be discussed. Major components of a brake system, including calipers, boosters, master cylinders, drum brakes, and park brakes are presented in detail highlighting the many design variations. An overview of the chassis control components and operating principles will be presented with an emphasis on ABS, traction control and stability control.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Design a brake system in compliance with Federal Motor Vehicle Safety Standards
- Calculate the ideal brake balance for a vehicle under any loading condition
- Calculate the actual brake balance and brake output for a selected set of brake components and evaluate the effects of changing component parameters
- Determine the effects of variation in component parameters on the system performance
- Describe the basic function of major brake components
- Describe various chassis control systems and their role in vehicle safety
- Determine the appropriate design variation for a particular application

WHO SHOULD ATTEND

Engineers interested or responsible for the specification, prediction and validation of braking system performance. It will also benefit engineers responsible for brake component design.

CONTENT HIGHLIGHTS

- System Level Requirements
- Brake Balance and System Output Calculations
- Workshop - design a brake system and predict the performance to key system level targets
- Component Functional Review
- Workshop - determine the effects of component variation on design
- Anti-lock Braking Systems
- Advanced Concepts and Technology

INSTRUCTOR

Thomas J. Hall
Owner/Manager, MaxG Technology LLC

"This was an excellent overview of the topic, but it dealt with enough specifics to give me a good knowledge base to help me do my job better."

Alan S. Halvorson
Project Engineer
Harley-Davidson Motor Company

I.D.# C0509

SCHEDULE
November 1-3, 2017
Troy, Michigan

FEES

List:	$1,745
Members	
Classic:	$1,571
Premium:	$1,483
Elite:	$1,396

THREE-DAYS/2.0 CEUS

Get more information and register: training.sae.org/seminars/c0509/

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COMMERCIAL VEHICLE BRAKING SYSTEMS

Increased public pressure to improve commercial truck safety and new stopping distance regulations have intensified the need to better understand the factors influencing heavy vehicle braking performance. To assist you and your organization in preparing for these new truck braking standards, this seminar focuses you on understanding medium-duty hydraulic brake systems and heavy-duty air brake systems and how both systems' performance can be predicted, maintained and optimized. The function and application of the major brake system components will be explained and you will discover how brakes, tires and roadways interact as a system. Federal braking regulations for both hydraulic and air brake vehicles will also be covered. You will receive the text, *Commercial Vehicle Braking Systems: Air Brakes, ABS and Beyond*, written by Leonard C. Buckman.

"An excellent course which provides a comprehensive overview of braking systems for Commercial Vehicles."

Earl Brown
Commercial Vehicle Sales Manager
TMD Friction

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Design safe and efficient braking systems
- Test and measure braking performance
- Maintain and troubleshoot braking systems
- Comply with state and federal regulations on brakes
- Describe the brake implications of accident investigation

WHO SHOULD ATTEND

This seminar is designed for engineers and technicians who are involved in the design, development and testing of heavy vehicle brakes. Fleet personnel involved with safety and brake system specification and maintenance, driver-trainers, and truck accident investigators will also find this course of value.

CONTENT HIGHLIGHTS

- Medium Truck Hydraulic Brake Actuation Systems
- Heavy Truck, Bus & Trailer Air Actuation Systems
- Brake Actuation Components - Function, Advantages/disadvantages, Applications
- Foundation Brakes - Cam, Wedge, Air Disc, Hydraulic Disc
- Braking Performance Fundamentals
- Maintenance and its Impact on Performance
- Brake Force Distribution
- Heavy Vehicle Dynamics and Tire Characteristics
- Thermal Considerations
- Tractor - Trailer Brake Compatibility
- Truck & Tractor Air Antilock Braking Systems
- Trailer Air Antilock Braking Systems
- Hydraulic Antilock Braking Systems
- Electronic Data Communication
- Automatic Traction Control Systems (ATC)
- Electronically Controlled Braking Systems (ECBS or "Brake-by-Wire")
- Electronic Stability Control and Roll Stability Control - Extended Applications of Electronics in Braking
- Brake Testing Procedures
- NHTSA and FMCSA Commercial Vehicle Brake Regulations

INSTRUCTOR

Paul Johnston
Senior Director of Compression and Braking, Meritor WABCO

I.D.# C0233

SCHEDULE
November 8-10, 2017
Troy, Michigan

FEES

List:	$1,770
Members	
Classic:	$1,593
Premium:	$1505
Elite:	$1,416

THREE-DAYS/2.0 CEUS

Get more information and register at: training.sae.org/seminars/c0233/

INTRODUCTION TO BRAKE CONTROL SYSTEMS: ABS, TCS, AND ESC

This comprehensive seminar introduces you to the system-level design considerations, vehicle interface requirements, and inevitable performance compromises that must be addressed when implementing electronic brake control systems.

The seminar begins by defining the tire-road interface and analyzing fundamental vehicle dynamics. Following an in-depth study of system electronics, hydraulic hardware, and sensor requirements, you learn about the control strategies employed by anti-lock brakes (ABS), dynamic rear proportioning (DRP), traction control (TCS), and electronic stability control (ESC) with strong emphasis placed on vehicle dynamic response. The seminar concludes with a study of unique applications, a look forward to advanced brake control system integration, and an overview of Federal Motor Vehicle Safety Standard 126. Over 500-pages of detailed course notes and illustrations are provided for on-the-job reference.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Analyze brake system design parameters and their vehicle performance effects
- Evaluate the compromises between stability, steerability, and stopping distance
- Identify the discrete mechanical components required for ABS
- Specify fundamental ABS performance attributes
- Calculate dynamic brake balance and explain the benefits of DRP
- Reconcile TCS performance expectations vs. method of implementation
- Define ESC metrics and ultimate dynamic limitations
- Assess features such as adaptive cruise control and brake assist
- Interpret federal requirements for the performance of ESC

WHO SHOULD ATTEND

This course has been developed for engineers involved in all fields related to the design or development of vehicle dynamics, vehicle braking systems, powertrain systems, chassis systems, or suspension systems. In addition, this course can be valuable to those with component design responsibilities in brake, chassis, suspension, or tire disciplines.

"My colleagues and I are extremely satisfied with this seminar. It has opened our eyes to an entirely new aspect of braking systems! I truly feel more interested in braking systems, and the instructor lectures provided such a good perspective on the technical aspects of design. Life after the course produced motivation and encouragement to research more heavily in critical areas of study per our future dilemmas. Thank you!!"

William J. Burns
Product Engineer
Cardone Industries,
Brakes Division Product Engineering

CONTENT HIGHLIGHTS

- Tire-Road Interface Characteristics
- Hydraulic Brake System Overview
- Stability, Steerability, Stopping Distance
- Mechanization of ABS
- ABS Sensor Overview
- ABS Performance
- DRP Performance
- Mechanization of TCS and ESC
- TCS and ESC Sensor Requirements
- TCS Performance
- ESC Performance
- Additional Features & Functionality
- Federal Motor Vehicle Safety Standard 126

INSTRUCTOR

James Walker, Jr.
Principal Engineer, Carr Engineering Inc.

SAE VEHICLE DYNAMICS CERTIFICATE PROGRAM

Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate program.

Designed to equip you with key vehicle dynamics and handling theory and application from a systems perspective, the objective of this program is for you to understand the interaction and performance balance between the major vehicle subsystems. The program design requires completion of fundamental and advanced-level vehicle dynamics theory and application courses with three elective courses that best suit your specific interest areas or engineering emphasis. View the list of required and elective courses and more information on enrolling in this SAE certificate program--training.sae.org/credentialing/certificate/vehicledynamics.htm

I.D.# C0315

SCHEDULE
October 23-24, 2017
Troy, Michigan

FEES

List:	$1,355
Members	
Classic:	$1,220
Premium:	$1,152
Elite:	$1,084

TWO-DAYS/1.3 CEUS

Get more information and register: training.sae.org/seminars/c0315/

ALSO AVAILABLE AS AN ON DEMAND COURSE.
Convenient, portable, and with core content from the instructor-led seminar, this 9.5-hour e-Seminar option offers an alternative way to receive the same instruction without the expense of travel and time away from the workplace. The course is divided into 13 video modules, accompanied by a handbook.

I.D. # PD130501ON

FEES

List:	$535
Members	
Classic:	$482
Premium:	$455
Elite:	$428

9.5-HOURS/ 1.0 CEU

View the complete course description and a video demo: training.sae.org/eseminars/pd130501on/

BRAKE SYSTEM BALANCE FOR PASSENGER CARS AND LIGHT TRUCKS

Designing a brake system requires the ability to balance a multitude of parameters against the required tradeoffs of system weight, system cost, and system performance. Understanding the basic fundamentals of how each brake component attribute contributes to the overall Force vs Deceleration behavior of the vehicle is critical to the design and release of a safe, legal and optimized system for today's vehicles. Brake balance also is a contributing factor to other chassis control and safety systems, such as regenerative braking, ABS, and electronic brake distribution (EBD).

This web seminar covers the fundamentals of the development of braking forces generated by the brake system and the theory and principals to properly balance a brake system in accordance with legal requirements. Brake balance modifiers will also be presented.

This live online course allows for a detailed presentation of this topic for those unable to participate in the longer and broader classroom seminar, *Hydraulic Brake Systems for Passenger Cars and Light Trucks*. See course information on page 27.

LEARNING OBJECTIVES

By participating in this web seminar, you will be able to:

- Calculate the braking force on a vehicle from the installed brake components
- Determine the deceleration achieved by a vehicle for a given set of brake components
- Analyze and interpret the actual brake balance for a given vehicle and brake components
- Calculate the ideal brake forces required for a vehicle
- Evaluate tradeoffs between actual and ideal brake forces
- Calculate the impact of brake balance modifiers on vehicle braking performance

WHO SHOULD ATTEND

This course is designed for engineers interested in or responsible for: the specification, prediction and validation of braking system performance; brake component design by providing insight into the interaction of components and the contribution to system level performance metrics; the tuning and calibration of Chassis Control Systems including ABS, TCS, ESP, ROM and Regenerative Braking Systems. Practical experience in the design or validation of brake or chassis control systems is helpful in getting the most from this course.

CONTENT HIGHLIGHTS

- Brake System Sizing – Brake Force Determination
  - Applicable legal requirements for a brake system
  - Derivation of brake input force vs. vehicle deceleration relationship
- Actual Brake Force Balance and Considerations
  - Derivation of actual brake force balance
  - Determination of special actual brake balance conditions (front only, rear only)
- Brake Balance Analysis
  - Derivation of ideal brake force balance for a vehicle
  - Tradeoff analysis between actual brake force and ideal brake forces
  - Utilizing brake balance modifiers to refine the brake system

INSTRUCTOR

Thomas J. Hall
Owner/Manager, MaxG Technology LLC

I.D.# WB1413

SCHEDULE
September 11-15, 2017
Live Online

FEES

List:	$550
Members	
Classic:	$495
Premium:	$468
Elite:	$440

THREE, 2-HOUR SESSIONS/.6 CEUS

Get the complete course description and register:
training.sae.org/webseminars/wb1413/

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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. 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.

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
- Introduction to Brake NVH Problem Resolution

INSTRUCTOR

Eric Denys
Vice President of Global OE Brake and AM Integration, Wolverine Advanced Materials

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

I.D.# C1337

SCHEDULE
September 28, 2017
Orlando, Florida
Held in conjunction with the SAE 2017 Brake Colloquium

FEES

List:	$810
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ONE-DAY/.7 CEUS

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2017 LIVE LEARNING SCHEDULE

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

Troy, MI, USA - SAE International Troy Office

Aug 14-15	Design of Experiments (DOE) for Engineers – I.D.# C0406
Aug 15-16	Selective Catalytic Reduction for Diesel Engines – I.D.# C0913
Aug 16	Common Rail Diesel Fuel Injection – I.D.# C0920
Aug 16-18	Weibull-Log Normal Analysis Workshop – I.D.# 86034
Aug 17-18	Design for Manufacture and Assembly (DFM/DFA) – I.D.# C0418
Aug 21-22	New! Fundamentals of Vehicle Suspension Design – I.D.# C1618
Aug 28-30	Managing Engineering & Technical Professionals – I.D.# C0608

Livonia, MI, USA - Effective Training Inc.

Aug 29-30	Fundamentals of GD&T 1994 – I.D.# ET2401

Tysons, VA, USA - LMI (Logistics Management Institute)

Aug 22-23	New! AS9100:2016 Rev D: Transitioning to the New Requirements – I.D.# C1633

Live Online

Aug 1-10	Vehicle Sound Package Materials – I.D.# WB1204
Aug 15-17	Diesel Engine Noise Control – I.D.# WB1041
Aug 21-25	New! Keys to Creating a Cybersecurity Process from the J3061 Process Framework – I.D.# WB1604
Aug 22-24	Overview and Impact of the Automotive Functional Safety Standard ISO 26262 – I.D.# WB1134

Troy, MI, USA - SAE International Troy Office

Sep 7-8	The Role of the Expert Witness in Product Liability Litigation – I.D.# 92054
Sep 11-12	Exhaust Gas Recirculation (EGR) for Diesel Engines – I.D.# C1214
Sep 14-15	Control Systems Simplified – I.D.# C0525
Sep 14-15	Hybrid and Electric Vehicle Systems – I.D.# C1504
Sep 18-20	Fundamentals of Steering Systems – I.D.# C0716
Sep 21-22	Accelerated Test Methods for Ground and Aerospace Vehicle Development – I.D.# C0316
Sep 21-22	Engine Failure Investigation and Analysis – I.D.# C1344
Sep 25-26	A Familiarization of Drivetrain Components – I.D.# 98024
Sep 25-26	Engineering Project Management – I.D.# 99003
Sep 27	Fundamentals of Automotive All-Wheel Drive Systems – I.D.# C0305
Sep 27-29	Turbocharging Internal Combustion Engines – I.D.# C0314
Sep 28-29	Controller Area Network (CAN) for Vehicle Applications – I.D.# C0120

Warrendale, PA, USA – SAE International Warrendale Office

Sep 27-29	New! AS9100D Internal Auditor Training– I.D.# C1633

Ft. Worth, TX, USA - Ft. Worth Convention Center—In conjunction with the SAE 2017 AeroTech Congress & Exhibition

Sep 28	Introduction to Composites Fabrication and Assembly in Aerospace, Space, and Transportation – I.D.# C1311
Sep 28-29	Failure Modes and Effects Analysis (Product & Process) in Aerospace – I.D.# C0939
Sep 28-29	Fundamentals of GD&T 2009 – I.D.# ET1150
Sep 28-29	Understanding and Supporting Aircraft Accident Investigation and Reconstruction – I.D.# C1143
Sep 29-30	Automated Systems for Aerospace and Space Applications – I.D.# C1313

Orlando, FL, USA – JW Marriott Orlando Grande Lakes—In conjunction with the SAE 2017 Brake Colloquium & Exhibition

Sep 28	The Tire as a Vehicle Component – I.D.# C0101
Sep 28	Introduction to Brake Noise, Vibration, and Harshness – I.D.# C1337
Sep 28	Brake Friction Materials: Testing, Quality and Selection – I.D.# C1020
Sep 29	Tire and Wheel Safety Issues – I.D.# C0102
Sep 29	Brake Noise Problem Resolution – I.D.# C0831

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EVENTS

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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 this event, you will have the opportunity to participate in lively panel discussions, an unrivaled technical program, and a dynamic exhibition. This Colloquium covers critical developments in both the ground vehicle and motorcycle industries. Make plans now to attend with your colleagues from around the world and learn about the latest technology developments.

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October 10-12, 2017
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