University of Akron 57th Tire Mechanics Short Course

Deutsche Messe, Hannover, Germany, March 1-4, 2027

The 57th Tire Mechanics Short Course will be held concurrently with Tire Technology Expo 2027 in Hannover, Germany, on March 1-4, 2027.

Contact Information

Course Information

Dr. Xiaosheng Gao

Department of Mechanical Engineering

College of Engineering and Polymer Science

The University of Akron

Akron, OH 44325-3903 USA

Tel: +1 330 972 2415

xgao@uakron.edu

Registration Information

Tim Sandford

Conference director, UKi Media & Events

Abinger House, Church Street

Dorking, Surrey, RH4 1DF, UK

Tel: +44 1306 743744

Fax: +44 1306 877411

tim.sandford@ukimediaevents.com

Program Schedule

Monday, March 1, 2027

09:00 – 09:30

Welcome and Introduction

Dr. Xiaosheng Gao

Department of Mechanical Engineering, College of Engineering and polymer science
The University of Akron, Akron, OH. USA

09:30 – 16:30 (Complimentary Lunch 12:00-13:00)

TIRE COMPONENTS, TIRE COMPOUNDS AND TIRE MATERIALS

Dr. Annette Lechtenböhmer
Goodyear Innovation Center, Luxembourg (retired); President - The Tire Society, co-editor, Tire Science and Technology Journal

This lecture gives an overview of the tire components, the demands on their compounds and the use of materials in these compounds. It attempts to make the connection between the role of components in a tire, the compound requirements of these components and the raw materials and cure which results in the desired compound properties. The lecture wants to close the loop between the raw materials and reinforcements used, the compound properties, tire preparation and cure, and final tire properties. The lecture will cover:

1. A Short Introduction
2. Components of a tire and demands
3. Tire compounds and their materials, including polymers, fillers, additives, sulfur, and curatives
4. Tire structures and composites, textile cords, wire, carcasses, beads, and belts
5. Processing, including mixing, calendaring, and extrusion
6. Tire building

Tuesday, March 2, 2027

09:00-16:30 (Complimentary Lunch 12:00-13:30)

THE TIRE AS A VEHICLE COMPONENT

Dr. Gerald Potts
GRP Consulting, Akron, OH, USA

Dr. Jim Cuttino, Presenter
Director of Advanced Engineering and Testing, Yokohama Corporation of North America, Cornelius, NC, USA

Modern pneumatic tires perform an extraordinary range of functions. They support vehicle loads, generate steering, driving, and braking forces, absorb road irregularities, and deliver consistent performance across a wide range of operating and environmental conditions. At the same time, they must satisfy demanding customer expectations for ride comfort, low noise, long wear, fuel efficiency, and overall performance.
This session explores the fundamental mechanics that enable tires to meet these seemingly conflicting requirements. Participants will gain a deeper understanding of the tire's critical role in vehicle dynamics, performance, and customer satisfaction.

Topics Covered:

- Mechanics of Force Generation in the Contact Patch
- Tire Performance: Cornering, Traction, and Braking
- Tuning the Tire for Desired Performance Characteristics
- Tire Influence on Vehicle Dynamics
- Tire Testing and Evaluation Methods
- Introduction to Tire Modeling and Simulation

16:30 – 18:00

Visit to the Exhibition

Wednesday, March 3, 2027

09:00 – 16:30 (12:00 – 13:30 Complimentary Lunch)

Impact of Rubber and Reinforcement Properties on Tire Footprint Mechanics

Dr. Mahmoud Assaad
Director of Technical Innovation, Endurica, Findlay, OH, USA

Global Tire Performance Prediction, Computational Mechanics
The Goodyear Tire & Rubber Co, Akron, OH. USA (Retired)

The viscoelastic behavior of the rubber compounds and the reinforcing cords influences the stability of the tire footprint shape. Additional physical properties such as the strain dependency of both constituents and their thermal stability contribute to the contact pressure distribution. The resultant tire forces and moments transmitted to the vehicle are measured using tri-axial force pin transducers or pressure-sensitive mats. The interaction between the materials' behavior and the tire global response controls the mechanics of tire readability and wear characteristics. The following topics will be discussed:

1. Mechanical properties of Rubber
   Elasticity and Viscoelasticity
   Strength of rubber compound
   Payne, Mullins Effects Energy
   Dissipation Strain Energy
   Release rate

Neural Network (Feed Forward-Back Propagation) based constitutive model for rubber material

2. Fibers and cords: load-displacement, creep, stress relaxation, and shrinkage; Impact of steel wires & polymeric cords on tire performance; Reinforcement adhesive coatings and processing
3. Tire transient force & moment response to slip angle sweep
   Footprint characteristics
   F&M measurement
   Cornering stiffness
   Small-medium-large slip angle regimes
4. Tire applications
   How tires age and how to measure aging in tires
   Tire electric resistance
   Tire pressure loss over time-impact of liner material and thickness
   Tire post cure inflation
   Tire digital twin technology

   Monitor health of tire using Continuum Damage Mechanics (CDM) 16:30 – 18:00

Visit to the Exhibition

Thursday, March 4, 2027

08:15 – 15:15 (12:00 – 13:00 Complimentary Lunch)

VIRTUAL TIRE MODELING for IMPROVED PERFORMANCE

Dr. Ronald Kennedy

Center for Tire Research, The University of Akron and Virginia Tech. Blacksburg, Va. U.S.A (Retired); Associate Editor of Tire Science and Technology Journal

Simulations are increasingly being used in companies' virtual design processes to develop a tire more effectively and efficiently with desired performance attributes. These simulation methods run the gamut from simple empirical or analytical models to highly detailed finite element models. These increasing levels of modeling will be described along with examples, with extended focus on the finite element modeling method. Various finite element modeling techniques will be shown as part of the tire performance simulation examples. The lecture will cover:

1. Tire load transfer, cord force, and tire shape mechanics and model representations
2. Review of tire performance modeling methods of increasing complexity, with examples ○ Empirical ○ Analytical
   ○ Physically based Numerical.
3. Brief introduction to tire finite element analysis (FEA)

4. Application of FEA to tire performance prediction ○ Tire/road contact and forces (static, rolling, cornering) ○ Rolling resistance ○ Tread wear ○ Durability ○ Hydroplaning

15:15 – 15:45

Course Evaluations and Distribution of Certificates

Dr. Xiaosheng Gao
Department of Mechanical Engineering
The University of Akron, Akron, OH, USA

Biographical Notes

Dr. Mahmoud C. Assaad

In 1983, Dr. Assaad earned his Ph.D. degree in Engineering Science and Mechanics as major and Applied Mathematics as minor from Iowa State University, Ames, Iowa. In 1979, he received a M.S. degree in Structural Engineering from the same university. In 1990, he received a M.S. degree in Polymer Science from The University of Akron (Akron, Ohio). In 1983, he joined The Goodyear Tire & Rubber Company. His current research interests include development of multiphysics simulation of tire performance including structural, thermal, and oxidative response. He is a lecturer at the Goodyear Institute of Technology. He was an Adjunct Assistant Professor in the Civil Engineering Department at The University of Akron and was also a lecturer at The University of Toledo. He Coauthored the composite segment of The Pneumatic Tire e-book, taught short courses on Plastics and Elastomers in Engineering Design in Italy, Luxembourg, and Germany. He was an invited speaker to the Gordon Conference on Fibers Science and to the 2009 “The Annual Workshops Materials’ Days at the University of Rostock”, Germany. He is currently working with ENDURICA as a Senior Technical Advisor.

Dr. Assaad was a recipient of the special Achievement Award from NASA for his meritorious accomplishments, dedicated work, and special efforts. He was the Winner of the “2008 Create the Future Design Contest” in the machinery/equipment category and served as a technical chairman for the 26th Anniversary of The Tire Society Conference. Dr. Assaad holds over 60 U.S., patents and trade secrets in U.S., and Europe.

Dr. James F. Cuttino

Dr. James Cuttino is Director of Advanced Engineering and Testing at Yokohama Corporation of North America, leading the development of advanced design tools, simulation, and testing technologies for Original Equipment and Replacement markets. Prior to joining Yokohama, he had served as Director of Tire Technologies and Product Line at LINK Engineering and was a research engineer at the Michelin Americas Research & Development Center. He earned B.S. and M.S. degrees from Clemson University and a Ph.D. in Precision Engineering from North Carolina State University.

Dr. Cuttino spent 14 years in academia, including founding the Motorsports and Automotive Research Center at the University of North Carolina at Charlotte, before launching Camber Ridge in 2009, an innovative tire testing company whose technology was acquired by LINK Engineering in 2017.

A recognized industry leader, he has served as Secretary and Vice President of The Tire Society and Chair of the SAE Truck and Bus Tire Committee. He is the author of nine patents, received an SAE Best Paper Award in 2013, and was the keynote speaker at the 2017 American Society for Precision Engineering Annual Meeting.

Dr. Ronald Kennedy

Dr. Ron Kennedy served as the Managing Director of the Center for Tire Research (CenTiRe), an industry/university consortium involving Virginia Tech, The University of Akron, and tire and tire-related companies. Before joining CenTiRe, he worked for 37 years in the tire industry at Firestone, Bridgestone/Firestone, and Hankook Tire performing tire finite element methods development and software programming, simulation systems development, advanced tire design, and tire factory uniformity studies. His work has covered the range of tire performance areas, manufacturing, and design. Dr. Kennedy is currently an Associate Editor of the Journal of Tire Science and Technology. He has numerous technical publications and presentations and has been awarded the Arch T. Colwell Merit Award from SAE, the Tire Society Superior Paper Award and an Honorable Mention Award, the CEO Award and President's Award from Bridgestone/Firestone. Dr. Kennedy was the Plenary Speaker at the 2017 Tire Society
Conference and gave the Keynote Address at the 2018 ACS Rubber Division Meeting. Ronald Kennedy received his BS and MS degrees in Engineering Mechanics from the University of Wisconsin, and his Ph.D. in Mechanical Engineering from The University of Akron.

Dr. Annette Lechtenböhmer

Annette Lechtenböhmer, a citizen of Germany, finished her studies of chemistry at Westfälische Wilhelms-Universität Münster, Germany, with a Ph.D. in Physical Chemistry in 1981. After two post doctorates, she was employed at the Goodyear Innovation Center in Luxemburg, she filled

positions within compounding and compound testing. She achieved the title of Senior Research Associate of Material Science. During her 35 years of experience in the rubber industry, she has accumulated profound knowledge of compound development, compound testing and test principles, viscoelasticity, compound processing, testing for material modelling and structure of tires, quality control and production. Her positions required close cooperation with other steps of tire development, production, tire design, construction, raw material suppliers, and scientific institutes and universities. In addition to her industry experience, she taught at Universität Hannover on "Tire Technology" for many years and lectured on "Elastomer Technology" at Luxemburg University. She holds several Patents and Trade Secrets. She is a member of Tire Society, German Chemical Society and German Rubber Society. She retired from Goodyear in 2020 but maintains her dedication to promote rubber and tire science. She continues teaching and serving as an Associate-editor of the Tire Science and Technology Journal. In June 2022, she was presented an award from the German Rubber Society at the International Rubber Conference for her special performances in research, technology, and economy.

Dr. Gerald Potts

Dr. Gerald Potts obtained his Ph.D. degree in Mechanical Engineering from Kansas State University. Upon graduation in 1970, he joined the Firestone Tire and Rubber Co. as a Research Scientist and Group Leader of the Dynamics Research Laboratory. In 1978, he became the Manager of Tire/Wheel Testing Systems at MTS Systems Corporation where he led the initial development of the Flat-Trace â tire test machine. Two years later, he was employed by the General

Motors Institute as an Associate Professor of Mechanical Engineering teaching Vehicle Dynamics and Mechanical Vibrations. In the meantime, he established his own company, G.R. Potts Associates, Inc. From 1984 to 1991, then becoming President of TMSI specializing in tire high speed uniformity test systems, tire rolling resistance testers, On LEVEL tire test systems and vehicle crash testing. In 2013, he sold TMSI to MESNAC Americas, LLC, and remains as President of TMSI LLC. Dr. Potts has traveled and lectured to engineering groups, world-wide, having delivered a Plenary Lecture at the 2006 Indian Rubber Institute Conference in Cochin, India. He holds ten patents, has been an Adjunct Professor of Mechanical Engineering at The University of Akron since 1974, and was awarded a Lifetime Achievement Award by Tire Technology International at the 2014 conference and Exhibition in Cologne, Germany.