Hybrid and Electric Vehicles

The Latest Research-Based Findings on Clean Vehicle Technologies

This short course covers all key topics in hybrid vehicles including modeling and control, batteries, battery management systems, motors and power electronics, and EMC.

Learn more and register for upcoming courses at: isd.engin.umich.edu/HybridVehicles
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6 Modules
Take them all, or just one. The choice is up to you

Who Should Attend
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Program Components

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- Introduction, Background
- Modeling of Hybrid Electric Vehicles
- Hybrid Vehicle Integration/Analysis
- Split Hybrid Electric Modeling and Control

Introduction to Electrical Energy Storage (or Battery Fundamentals)
- Introductory Material
- Key Components of Batteries and Their Properties
- Thermodynamics and Kinetics of Battery Operation
- Battery Chemistries Overview
- Li-Ion Batteries
- Models of Battery Operation
- Li-Ion Degradation Mechanisms
- Advanced Batteries
- Ultra-capacitors

Power Electronics for Electric Drive Vehicles
- Automobile Electrification
- Introduction to Power Electronics
- Modeling of Power Electronics
- Rectifiers (AC-DC)
- Unidirectional DC-DC Converters
- Bidirectional DC-DC Converter
- Power Electronics Building Blocks
- Thermal Issues in Power Electronics
- Hardware in the Loop
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- Battery Chargers
- Vehicle to Grid (V2G)
- Emerging and Future Technologies
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- Battery Charge Algorithms
- Battery Safety
- Future Technologies in BMS

Hybrid and Electric Vehicle Special Topics
- Off Road HEV, Hydraulic Hybrid, and Non-Automotive Applications
- Off Road-HEV Overview
- Hydraulic Versus Electric HV
- Non-Automotive Applications
- Deployment Decision Making Process for HEV for Different Types of Vehicles

Military Applications of HEV
- Benefits
- Ground Vehicle Applications
- Architecture—Series, Parallel, Complex
- Non-automotive applications in military
- ruggedness issues
- Vehicles which are most beneficial
- Diagnostics, Prognostics, Reliability, and NHV of HEV
- What is Involved
- System Health Quantification
- Reliability of HEV
- EMC Issues
- Noise Vibration Harshness Issues (NVH)
- Electromechanical and Others
- End of Life Issues
- EMC System Engineering Approach to Hybrid and Electric Vehicles
- EMC System Engineering of a Vehicle Architecture
- Battery System Testing Challenges
- Grounding Principles for Hybrid and Electric Vehicle Systems Shielding
- EMC System Engineering Verification and Validation Model

Program Details

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ISD responds to the needs of industry, healthcare, government, the military, and non-profit organizations with specialized education programs.

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Program Instructors

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is presently with the US Army RDECOM-TARDEC (R&D) where he has been involved in research related to hybrid electric vehicles, vehicular electric power system architecture concept design and development, electric power management, and artificial intelligence based fault diagnostics in electric drives. He is also an Adjunct Professor in the University of Detroit Mercy where he has been teaching courses related to Advanced Electric and Hybrid Vehicles.

Dr. Chris Mi
is an associate professor of Electrical and Computer Engineering and director of DTE Power Electronics Laboratory at the University of Michigan–Dearborn. His research interests are in power electronics, electric machines, and their applications in HEVs and renewable energy systems.

Dr. Huei Peng
is a professor of Mechanical Engineering at the University of Michigan–Ann Arbor. His research interests include modeling and control of hybrid vehicles, fuel cell vehicles, and advanced power-train techniques.

Dr. Don Siegel
is an assistant professor of Mechanical Engineering at the University of Michigan. His research interests include development of high-capacity materials and systems for energy storage applications, computational materials science, multi-scale modeling and more.

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has extensive experience in EMC design, analysis, and testing. His background includes over twenty years of specialized EMC systems experience at X2Y Attenuators, DaimlerChrysler, and United Technologies.

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