GATE Center for Electric Drive Transportation at the University of Michigan - Dearborn

PI: Chris Mi

Presenter: Chris Mi

University of Michigan-Dearborn

May 15, 2012

Project ID #
TI020

Overview

Timeline

- Project start date: 9/1/2011
- Project end date: 8/31/2016
- Percent complete: 5%

Budget

- Total project funding: $1,249,977
  - DOE share: $999,981
  - Contractor share: $249,996
- Funding received in FY11: $72,420
- Funding for FY12: $294,391

Barriers

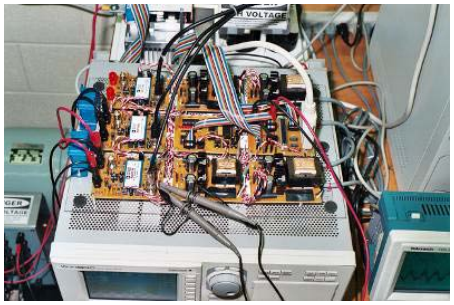
- Barriers addressed
  - Lack of trained engineers and scientists
  - Lack of advanced technology curricula
  - Automotive industry in high demand of knowledgeable and experienced workforce

Partners

- Chrysler, Ford, GM, ANSYS, Visteon, Yazaki, Mathworks, and other 15+ industry partners
- Industry partners serve industrial advisory board (IAB) and additional funding support

UM-Dearborn GATE Objectives

- Establish concentration in electric drive transportation in MS and Ph.D programs in Automotive Systems Engineering (ASE) at UM-Dearborn
- Develop seven new courses in EDV
- Develop a series of short courses in EDV
- Offer 5 new graduate fellowships per year
- Enhance research in seven thrust areas
- Establish an Industry Consortium on EDV to support the above initiative



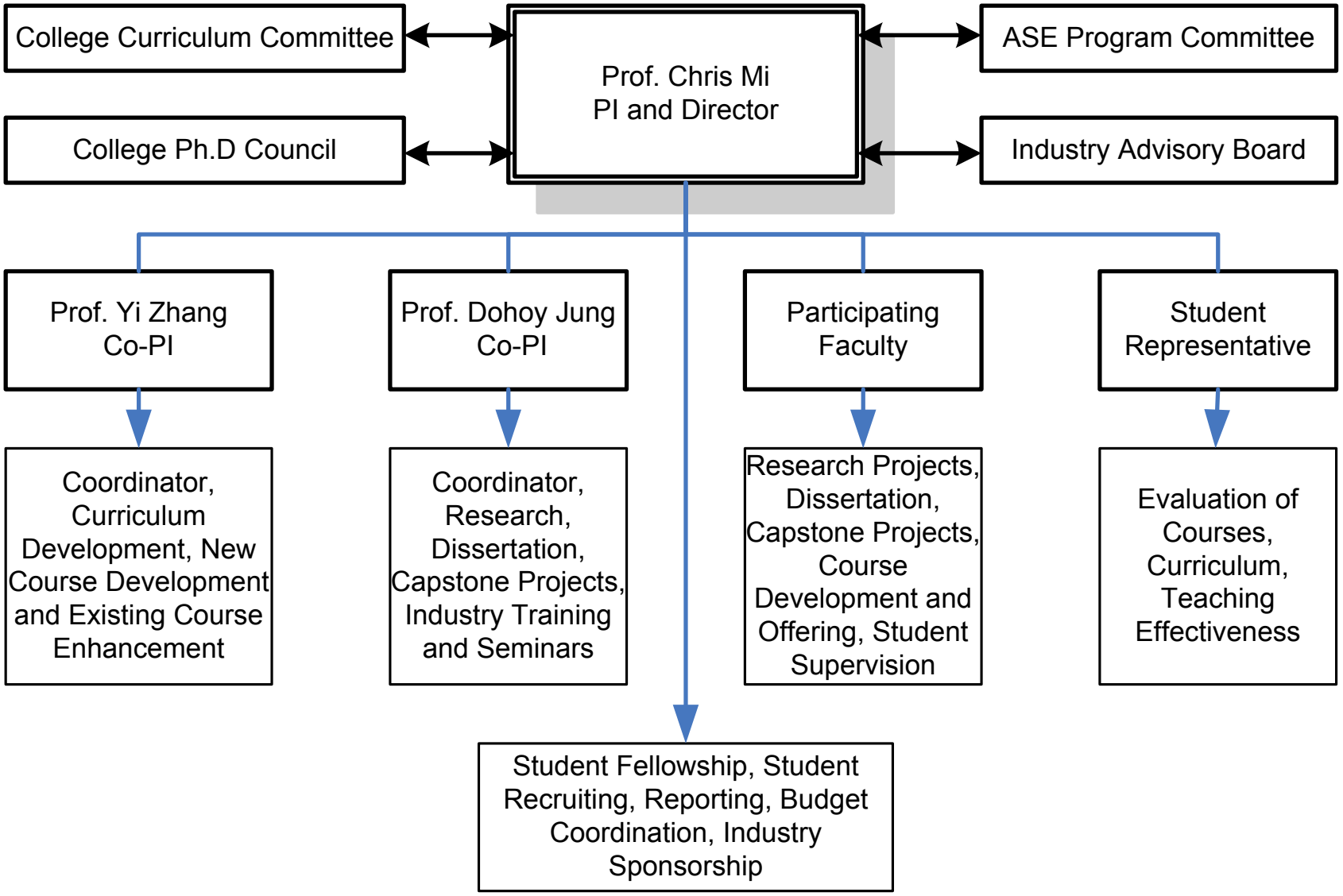
Milestones – Year 1

- **First Academic Year (09/01/2011-08/31/2012)**
  - Obtain approval of the new concentration by the College Curriculum Committee
  - Develop seven new courses for the EDT concentration in the ASE program
  - Offer two new courses
  - Revise the contents of four existing courses and offer one revised course
  - Recruit two to four graduate students for the GATE program fellowships
  - Receive industry support
  - Organize Center Annual Conference

Milestones – Year 2

- **Second Academic Year (09/01/2012-08/31/2013)**
  - Offer three additional new courses (total five)
  - Recruit four to six graduate students for the GATE program fellowships
  - Implement laboratory improvements and integration of lab with course contents
  - Offer three revised existing courses and implement changes
  - Offer industry training programs
  - Initiate Capstone projects
  - Accept Ph.D Candidates
  - Publish conference and journal papers
  - Approve dissertation proposals
  - Organize Center Annual Conference

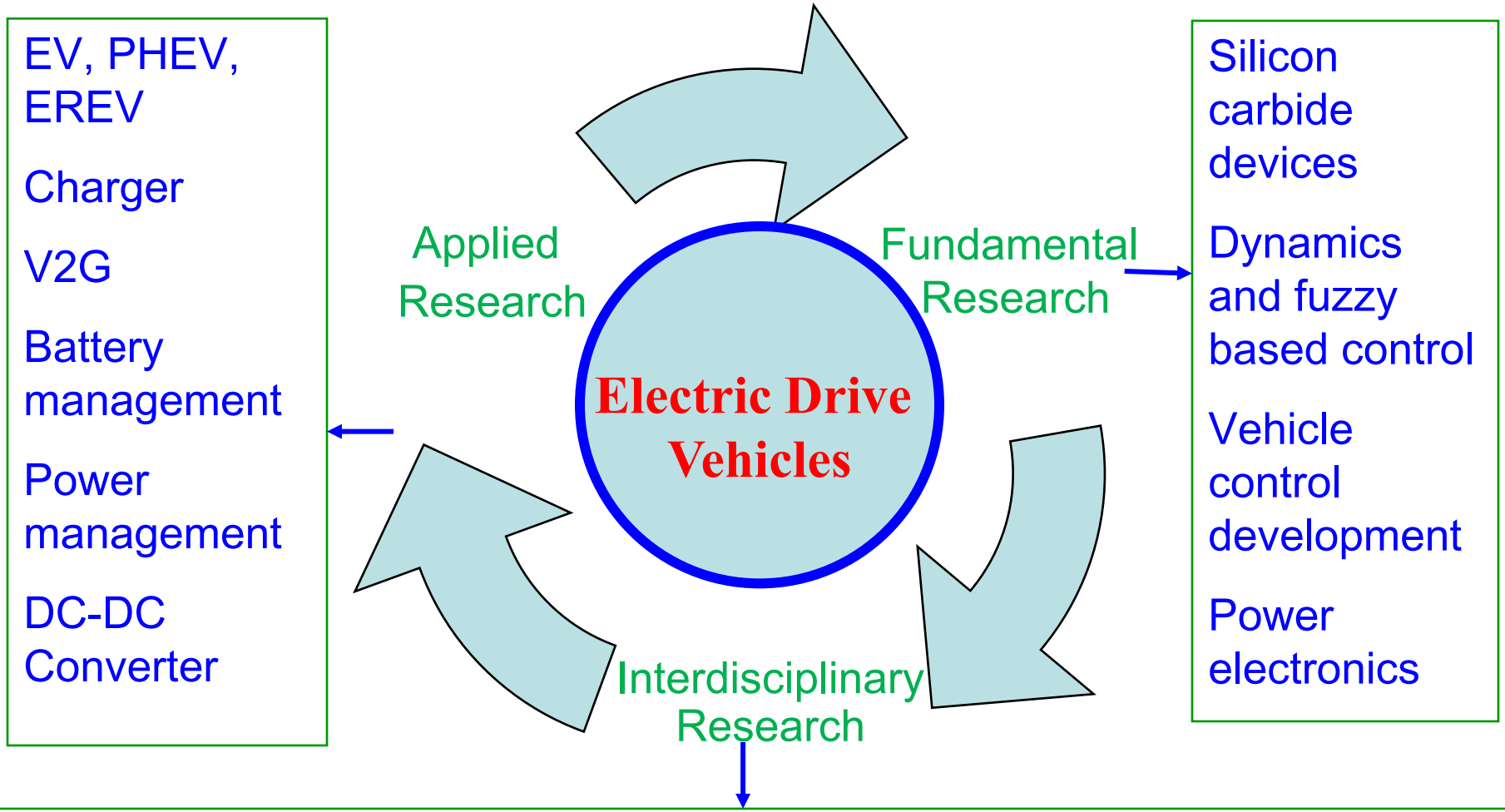
Center Management



Center Expertise

- Power electronics and electric machines (Dr. Mi, Dr. Kim, Dr. Guo)
- Hybrid powertrain control and power management (Dr. Zhang, Dr. Murphey)
- Battery management and control (Dr. Mi, Dr. Ratts, Dr. Jung)
- Thermal management of EDV (Dr. Ratts, Dr. Jung, Dr. Li)
- Vehicle to Grid (V2G), charging infrastructure, grid impact of EDV (Dr. Mi, Dr. Kim)
- Reliability, diagnostics, and prognostics of EDV (Dr. Xi)
- Noise, vibration and harshness (NVH) of EDV (Dr. Cherng, Dr. Zhang)

Center Approaches



Fund: DOE $1M; Automotive OEM/Supplier Consortium Membership

Ph.D Concentration in Electric Drive Transportation

- Required Courses
  - ASE502: Modeling of Automotive Systems
  - ENGR799: Doctoral Dissertation
  - ENGR798: Seminar
- Elective Courses: select 4 concentration courses listed below and 3 additional elective courses
  - ASE502 Energy Storage Systems
  - ECE5462 Hybrid Electric Vehicles
  - ASE566 Vehicle Thermal Management
  - ASE5791 Vehicle Power Management
  - ECE646 Adv. Electric Drive Transportation
  - ASE501 Energy Conversion Systems
  - ASE557 Powertrain NVH Analysis
  - ISE567 Reliability Analysis
  - ECE517 Advanced Electric Drives
  - ASE548 Automotive Powertrains II
  - ECE615 Adv. Power Electronics

MSE Concentration in Electric Drive Transportation

- Required Courses
  - ASE 698 Capstone Project or ASE 699 Master's Thesis
  - ASE500 Automotive Systems Engineering
  - ASE587 Automotive Manufacturing Proc
- Elective Courses: select 4 concentration courses listed below and 2 additional elective courses
  - ASE 502 Energy Storage Systems
  - ECE 5462 Hybrid Electric Vehicles
  - ASE 566 Vehicle Thermal Management
  - ASE 5791 Vehicle Power Management
  - ECE 615 Adv. Power Electronics
  - ECE 646 Adv. Electric Drive Transportation
  - ASE 557 Powertrain NVH Analysis
  - ISE 567 Reliability Analysis
  - ECE 517 Advanced Electric Drives
  - ASE 548 Automotive Powertrains II
  - ASE 515 Vehicle Electronics II
  - ECE 532 Automotive Sensors & Actuators

New Courses In the Curriculum

- ESE501: Energy Conversion Systems
- ESE502: Energy Storage Systems
- ECE615: Advanced Power Electronics
- ECE646: Advanced Electric Transportation
- ECE5791: Vehicle Power Management
- ASE 557: Powertrain NVH
- ASE 566: Vehicle Thermal Management

Enhancement of Existing Courses

- ASE548: Automotive Powertrains II
- ECE5462: Hybrid Electric Vehicles
- ECE517: Advanced Electric Drives
- ISE567: Reliability Analysis

Fundamentals of Electric Drive Vehicles Short Course

- Day 1:
  1. Chris Mi, Fundamentals of EV, HEV, and PHEV, Chris Mi, 3 hours
  2. Taehyung Kim, Power electronics and electric drives for electric drivetrain applications, 2 hours
  3. Yi Zhang, Hybrid Powertrain topology and dynamics, 2 hours
- Day 2:
  4. Yi Lu Murphey, Intelligent vehicle power management, 3 hours
  5. Dohoy Jung, Thermal management of electric drive vehicles including waste heat recovery, 2 hours
  6. John Cherng, Noise, vibration, and harshness of electric drive vehicles, 2 hours
- Day 3:
  7. Chris Mi, Battery management systems, 3 hours
  8. Zhinmin Xi, Reliability of electric drive vehicles, 2 hours
  9. Wei Guo, Application of Nanotechnology, 2 hours
  10. Ted Bohn, Codes and standards, 2 hours

Nominal Cost $99 for industry partners

Industry Partnership - Benefits

- Non Exclusive, royalty free IP for internal use
- Access to recent, not-yet-published GATE Center research
- Access to GATE Center prepublications and presentations
- Early access to intellectual property developed by GATE Center
- Access to the GATE Center facility
- Serve on the Industry Advisory Board which helps to guide GATE Center management, curriculum, research etc.
- Attend GATE Center annual conference that includes presentations by GATE Center researchers and member companies
- Free or discounted attendance of seminar, short course, training
- Networking opportunities with faculty, students, and industry partners
- Jointly submitting proposals to federal programs, such as SBIR/STTR, that encourage university-corporate partnerships
- Priority access to students for internships and employment
- Opportunity to teach courses/subjects/seminars for the center

Industry Partnership - Structure

Member Benefits	Full Member	Associate Member	Affiliate Member
Seat on the IAB	X	X	X
Non Exclusive, royalty free IP for internal use	X	X	
First option to license center IP	X		
Access to center facility	X	X	
Priority access to students intern/employ.	X	X	X
SBIR/STTR collaboration	X	X	X
Free access to seminar/training/short courses	X	X	discounted
Contribution	$30,000	$15,000	$1500

Industry Advisory Board (IAB) - Role

- Receives annual reports of the Center
- Reviews curriculum of the GATE Center and make recommendations for curriculum, new courses, and course contents
- Makes recommendations for research projects
- Selects projects of mutual interest to be funded from Membership fees in each Fiscal Year
- Attends the semi-annual IAB meetings (arrange an alternate if the IAB member is not available)
- Reviews industry membership structure, fee structure, and new members applications
- Elects IAB Chair who will coordinate the IAB meetings, and a vice chair to help the chair and serves acting chair if the chair is not available, and as Chair-elect
- The IAB Chair shall serve a one year term
- The IAB Vice Chair shall serve a one year term followed by a one year term as IAB Chair

IAB Members

- Mengyang Zhang, Senior Technical Specialist, Electrified Powertrain Program, Chrysler Group, LLC.
- Jim Romine, Executive Vice President of Engineering, Yazaki North America
- Chuck Gray, Chief Engineer, Core Electrification Engineering, Ford Motor Company
- Pete Savagian, EngineeringDirector, Hybrid and Electric Architecture and Electric Motors, General Motors
- Dr. Bill Post, Honda R&D North Americas
- Scott Stanton, Technical Director, Advanced Technology Initiatives, ANSYS
- Hawk Asgeirsson, Manager, Power Systems Technologies, DTE Energy
- Tim Yerdon, on behave of Joy Greenway, President, Climate Product Group, Visteon Corporation
- Dr. Chris Dries, CEO, United Silicon Carbide
- Erik Limpaecher, Chief Technical Officer, Princeton Power Systems, Inc.
- Theodore Bohn, Principal Electrical Engineer, Argonne National Laboratory

IAB Members - Continued

- Brian Wynne, President, Electric Drive Transportation Association
- Konrad Weeber, Technology Leader, General Electric
- Tomy Sebastian, Chief Scientist, Nexteer Automotive
- Jan Ladewig/ Rolf Balte, Director for Research and Development, Hp Pelzer Group
- Mark Zachos, President, Dearborn Group
- Wensi Jin, Industry Manager, Mathworks
- Ed Han, VP of Engineering, Wei Cai China
- Zed Tang, Chief Engineer, Advanced Automation Group
- Mahendra Muli/Chloe Murphy, Director of Business Development, dSPACE Inc.
- Joe Bolsenga, VP Marketing and Technical Support, STMicroelectronics
- Paul Fox, STMicroelectronics
- Kevin Pavlov, VP Engineering, Magna Ecar
- Bruno Lequesne, Eaton, President IEEE IAS Society, Eaton
- Ayman El-Refaie, General Electric, (Via Phone)

First IAB meeting was held on December 9, 2012, with 20 companies and 25 representatives

Next IAB Meeting and

GATE Annual Meeting, in conjunction with the CEEP Anniversary
May 17, 2012

GATE Fellows

- Three in the program in January 2012:
  - Jinghai Xu, Ph.D Candidate
  - Chenwen You, MS
  - Xianzhi Gong, Ph.D Student
- Fall 2012, Three to five potential students

New Courses Offered

- Winter 2012, New Courses
  - ECE646: Advanced Electric Drive Transportation
  - ESE502/ECE532: Energy Storage
- Fall 2012, New Courses
  - ECE615: Advanced Power Electronics
  - ASE566 Vehicle Thermal Management
  - ESE501: Energy Conversion Systems
- Fall 2013, New Courses
  - ASE557: Powertrain NVH
  - ECE5791: Vehicle Power Management

Revised/Enhanced Courses

- ASE548: Automotive Powertrains II, Winter 2012
- ECE5462: Hybrid Electric Vehicles, Winter 2012
- ECE517: Advanced Electric Drives – Fall 2013
- ISE567: Reliability Analysis – Winter 2014

Center Website

UNIVERSITY OF MICHIGAN-DEARBORN
COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

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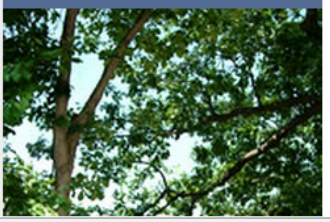

CENTER FOR ELECTRIC DRIVE TRANSPORTATION

DOE GATE Center for Electric Drive Transportation

The Center for Electric Drive Transportation (CEDT) at the University of Michigan-Dearborn is established in 2011 with a grant from the U. S. Department of Energy's Graduate Automotive Technology Education (GATE) Program.

The GATE Program was first established in 1998 with 5 centers. This year (2011), it marks the third generation of 7 GATE Centers:
- **University of Michigan - Dearborn**
- Purdue University
- The Ohio State University
- Pennsylvania State University
- Clemson University
- The University of Colorado & Colorado Springs
- University of Alabama

DOE's GATE initiative will award $6.4 million over the course of 5 years to support those 7 Centers of Excellence at American colleges, universities, and university-affiliated research institutions. The awardees will focus on 3 critical automotive technology areas: hybrid propulsion, energy storage, and lightweight materials. By funding curriculum development and expansion as well as laboratory work, GATE allows higher education institutions to develop multidisciplinary training. As a result, GATE promotes the development of a skilled workforce of engineering professionals who will overcome technical barriers and help commercialize the next generation of advanced automotive technologies.

As one of the seven university research centers that were awarded the prestigious grants, CEDT is dedicated to achieving the synergy among technological development, research and graduate education in automotive engineering, with a focus on the following thrust areas that are crucial for the development of electric drive transportation:

- Power electronics and electric machines
- Hybrid powertrain control and power management
- Battery management and control
- Thermal management of Electric Drive Vehicles (EDV)
- Vehicle to Grid (V2G), charging infrastructure, grid impact of EDV
- Reliability, diagnostics, and prognostics of EDV
- Noise, vibration and harshness (NVH) of EDV

Want More Information ?

DOE GATE Center for Electric Drive Transportation is featured on UM Record Update

About DOE GATE Program:
http://energy.gov/articles/graduate-automotive-technology-education-gate-initiative-awards

CEDT PI and Director:
Prof.Chris Mi
Web:http://www-personal.engin.umd.umich.edu/~chrismi/

Phone: 313-583-6434
Email: chrismi@umich.edu

A Free 3-Day Training Course on EV,HEV,and PHEV will be offered by GATE CEDT

The GATE Center for Electric Drive Transportation at the University of Michigan-Dearborn is pleased to offer a low-cost, three-day training seminar for the GATE partner companies. Participants that complete all three days of training will be awarded 2.4 CEUs (continuing education units) upon request.

Registration link:
http://www.engin.umd.umich.edu/EPD/data

Proposed Future Work

- Actively recruit GATE Fellows.
- Sign agreements with industry partners and secure membership fees.
- Offer scheduled courses in the curriculum.
- Organize GATE Annual meeting and IAB meeting.
- Promote GATE Center at conferences in the field of electrified vehicles, such as IEEE Electric Vehicle Conference.
- Offer industry training programs
- Initiate Capstone projects
- Accept Ph.D Candidates
- Approve dissertation proposals

Summary

- Obtained approval of the new concentration by the College Curriculum Committee
- Developed and offered four new courses for the EDT concentration in the ASE program
- Revised and offered the contents of two existing courses
- Recruited three graduate students for the GATE program fellowships
- Set up framework for the industry partner program and agreements/bylaw is in review by IAB members
- Organized the first industrial board meeting
- Offered first three-day industry training at nominal cost