UC Davis Fuel Cell, Hydrogen, and Hybrid Vehicle (FCH^2V) GATE Center of Excellence

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This presentation does not contain any proprietary or confidential information

Outline – UC Davis GATE Center

- Brief History
- Main Goal & Objectives
- Focus research areas
- Classes
- Outreach and Publications
- Application Process
- Graduate Research Projects
- Summary

The Merging of the GATE Centers at UC Davis

GATE Fuel Cell Center of Excellence 1999-2004

GATE Hybrid Electric Vehicle Center of Excellence 1999-2004

Fuel Cell, Hydrogen, & Hybrid Vehicle (FCH2V) Center of Excellence

2005-2010

FCH^{2}V Goals & Objectives

Goals:

- Train future engineers to ensure the United States remains competitive

- Conduct research in the area of advanced automotive technology

Objectives:

- Support research of FCH^{2}V technology (graduate fellowships, selected with a *competitive* proposal process)
- Support dissemination of FCH^{2}V research results & knowledge (publications, outreach and workshops)
- Support curriculum development around FCH^{2}V technology (expand and enrich course offerings)
- Support industrial/government collaboration of FCH^{2}V technology (workshops, graduation placement, internships)

Cross Training for Transportation Leaders

Energy and Transportation Policy

Emissions Control

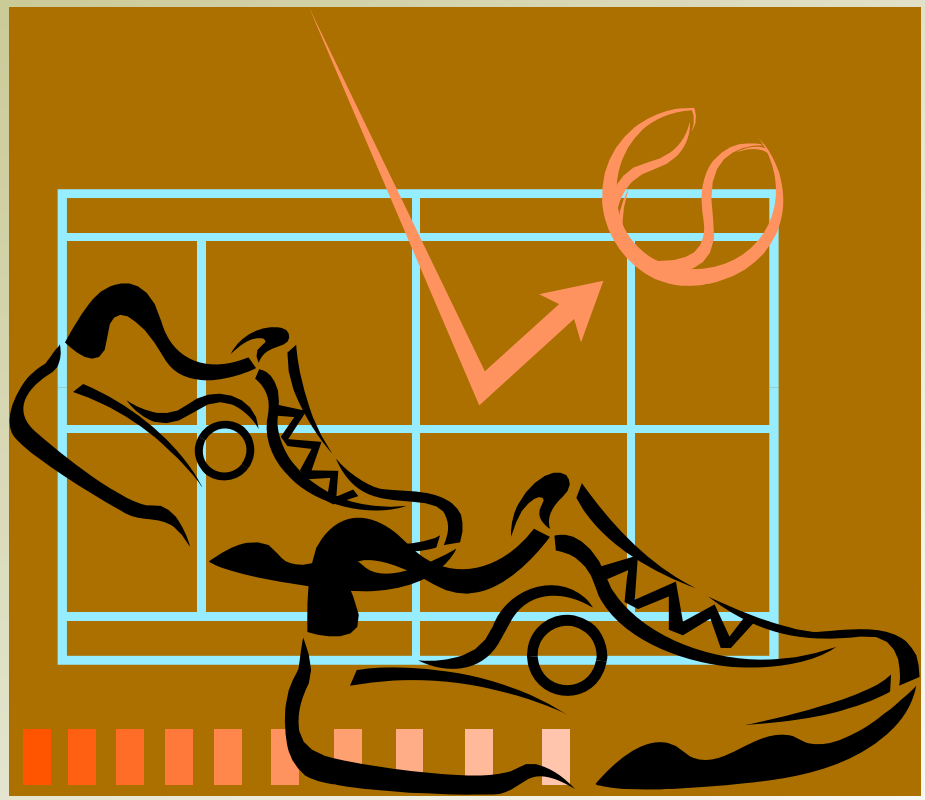
Aerodynamics

Transmissions

Internal Combustion

Advanced power cycles

Batteries and Capacitors



Hydrogen Production

Energy Efficiency

Life-Cycle Analysis

Instrumentation

Fuel Cell Chemistry

Hybridization

Collaboration of Departments:
ITS and College of Engineering

FCH²V Center Research Areas

- Fuel Cell and Hybrid Component Level Research
  - Energy storage (batteries, ultracapacitors)
  - Continuously variable transmissions (CVT)
  - Emissions reduction with hybrid and hydrogen enabled technologies
  - Electronic Control systems
- Vehicle and Energy Systems Research
  - Vehicle systems modeling
  - Fuel cell auxiliary power units
  - System Integration
  - DOE Challenge X competition (Trinity)
- Fuel Pathway Analysis (STEPS Program)
  - Infrastructure economics
  - Environmental analysis

Leverages Existing Programs & Partners

Hydrogen Production And Utilization Laboratory

UCDAVIS

H2 Production & Utilization Laboratory
http://mae.ucdavis.edu/hypaul/index.htm

SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS
INSTITUTE OF TRANSPORTATION STUDIES
STEPS

H2 Pathways and STEPS Programs
http://steps.its.ucdavis.edu/

UCDAVIS teamfate

UC Davis Challenge X Team
http://www.team-fate.net/

FC Auxiliary Power for Trucks

ITS UCDAVIS

Research and Training Facilities

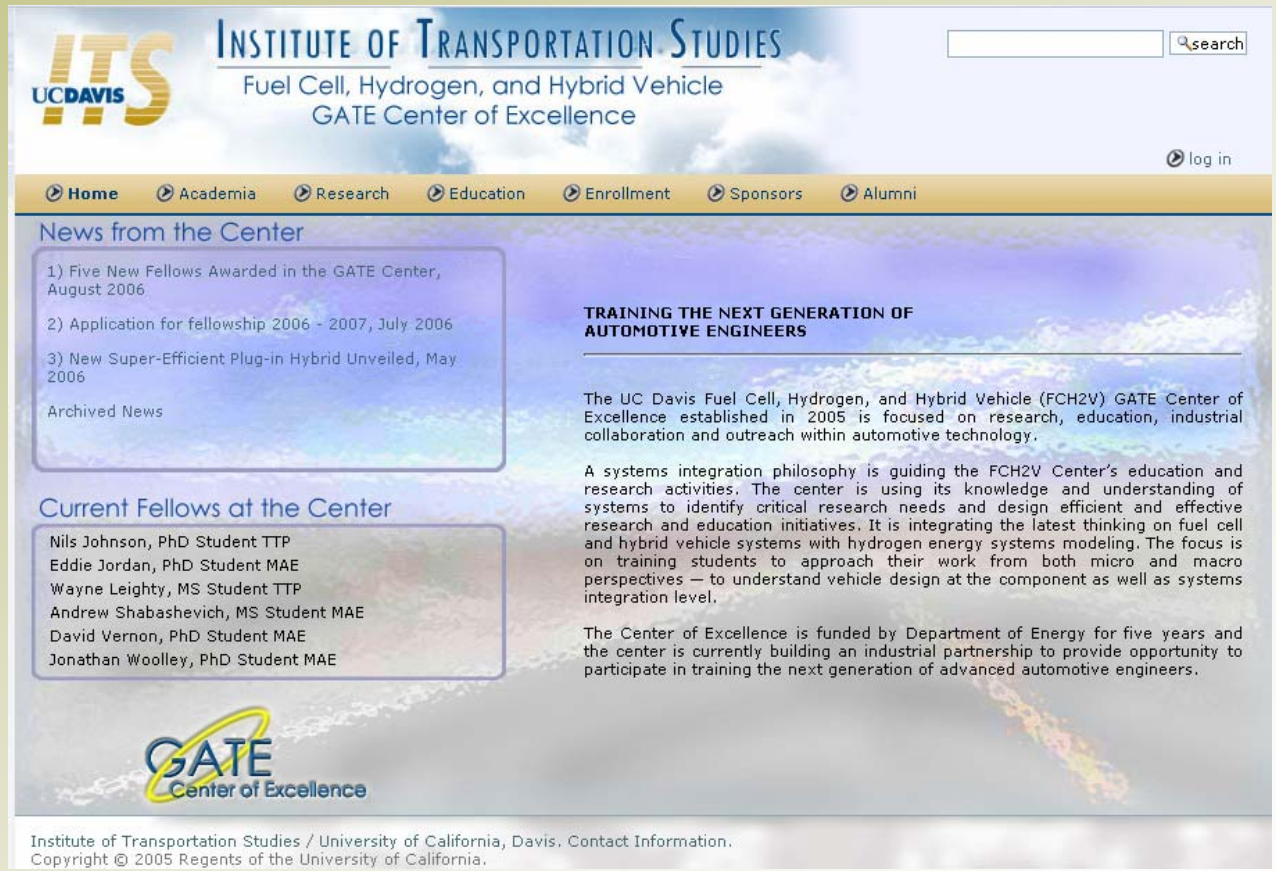
- *Hybrid Vehicle Power Systems Lab (ITS-Davis)*
- *Hybrid Vehicle Design, Assembly and Test Labs (MAE)*
- *Hydrogen Production and Utilization Lab (MAE)*
- *On-campus Hydrogen Refueling Station (ITS-Davis)*

FCH²V Center Curriculum

- Advanced Energy Systems (Course and Lab)
- Vehicle Systems Lab
- Hydrogen Pathways – Technology, Pathways, Economics and Policy
- Fuel Cell Systems
- FCH²V Center Electives, 40 classes available:
  - Mechanical and Aeronautical Engineering (MAE)
  - Chemical Eng. and Materials Science
  - Biological Systems Engineering
  - Electrical Engineering
  - Transportation Technology and Policy (ITS-Davis graduate group)

Outreach and Publications

Comprehensive website for outreach purposes and as a research collaboration tool



http://gate.its.ucdavis.edu

Application process

1. An updated CV
2. Current academic transcript
3. Complete twelve month research plan
4. Letter of sponsorship from a participating professor

Research Plan Components

1. *Research plan description*
2. *Expected contributions*
3. *Research Methodology*
4. *Literature review*
5. *Timeline and Deliverables*
6. *Interim publications*
7. *Interaction with other researchers*
8. *Personal Education Plan (as it relates to the research)*
9. *List of advisors and role each one will play in your research, including outside (non-academic) contacts*

GATE Graduate Fellowships

Competitive Award 2007 - 2008

- Andrew Shabashevich – Analysis of Waste Heat Recovery from Light-Duty Hybrid Electric Vehicles
- David Vernon – Thermal integration and system design for utilizing waste heat and exhaust gases
- Eddie Jordan - Hydrogen enriched ethanol combustion in IC engines
- Wayne Leighty - Structural Econometric Modeling of the Investment Timing Game in Alaska Oil and Gas Exploration and Development

Applications due March 31, 2008 for the 2008-2009 academic year

GATE Graduate Fellowships

Competitive Award 2005 - 2006

- David Vernon - Hydrogen Enrichment Via Chemical Recuperation to Increase Efficiency and Reduce Emissions in Engines.
- Brett Williams - Light-Duty Hydrogen-Fuel-Cell Vehicle Adoption in California: Early Markets, Vehicle-to-Grid Power, and “Mobile Energy” Innovation.
- Bryan Jungers - Improving the ITS-Davis Fuel Cell Vehicle Modeling Program (FCVMP): Incorporating Scalability, Transient Effects and Environmental Impact Analysis.
- Matt Caldwell – Hydrogen Production from Unpurified bio-derived alcohol mixtures: fundamental investigation of ATR and economic and infrastructure pathway analysis

Competitive Award 2006 - 2007

- Eddie Jordan - Hydrogen enriched ethanol combustion in IC engines
- Nils Johnson - Potential for coal-derived hydrogen with CCS
- Brett Williams – Hydrogen-Fuel-Cell Vehicle Adoption: Early California Markets, Vehicle-to-Grid Power, and “Mobile Energy” Innovation
- David Vernon – Thermal integration and system design for utilizing waste heat and exhaust gases
- Jonathan Woolley - Characterizing the hydrogen conversion trends associated with auto thermal reformation of octane ethanol mixtures.

UC Davis GATE Students

GATE Center (Year)	M.S. Candidates	Ph.D. Candidates
1999	1	1
2000	3	0
2001	6	1
2002	6	1
2003	2	0
2004	5	2
2005	0	4
2006	2	3
2007	1	3

Organizations that hired graduates:
UTC Fuel Cells, Ballard, Daimler, General Motors, Ford, Nissan, Toyota, Volkswagen, Agilent, ISE Corp., Aerojet, Electric Power Research Institute (EPRI), United Defense, Eaton, California Fuel Cell Partnership (CaFCP)

Summary / Key Lessons

- GATE program has expanded and strengthened the automotive technology research and education programs at UC Davis
- Leveraging with other programs allows for increased resources for research and strong interaction with other researchers
- Competitive process for student research awards works very well
- GATE builds human infrastructure

FCH^{2}V GATE Center - Building human infrastructure