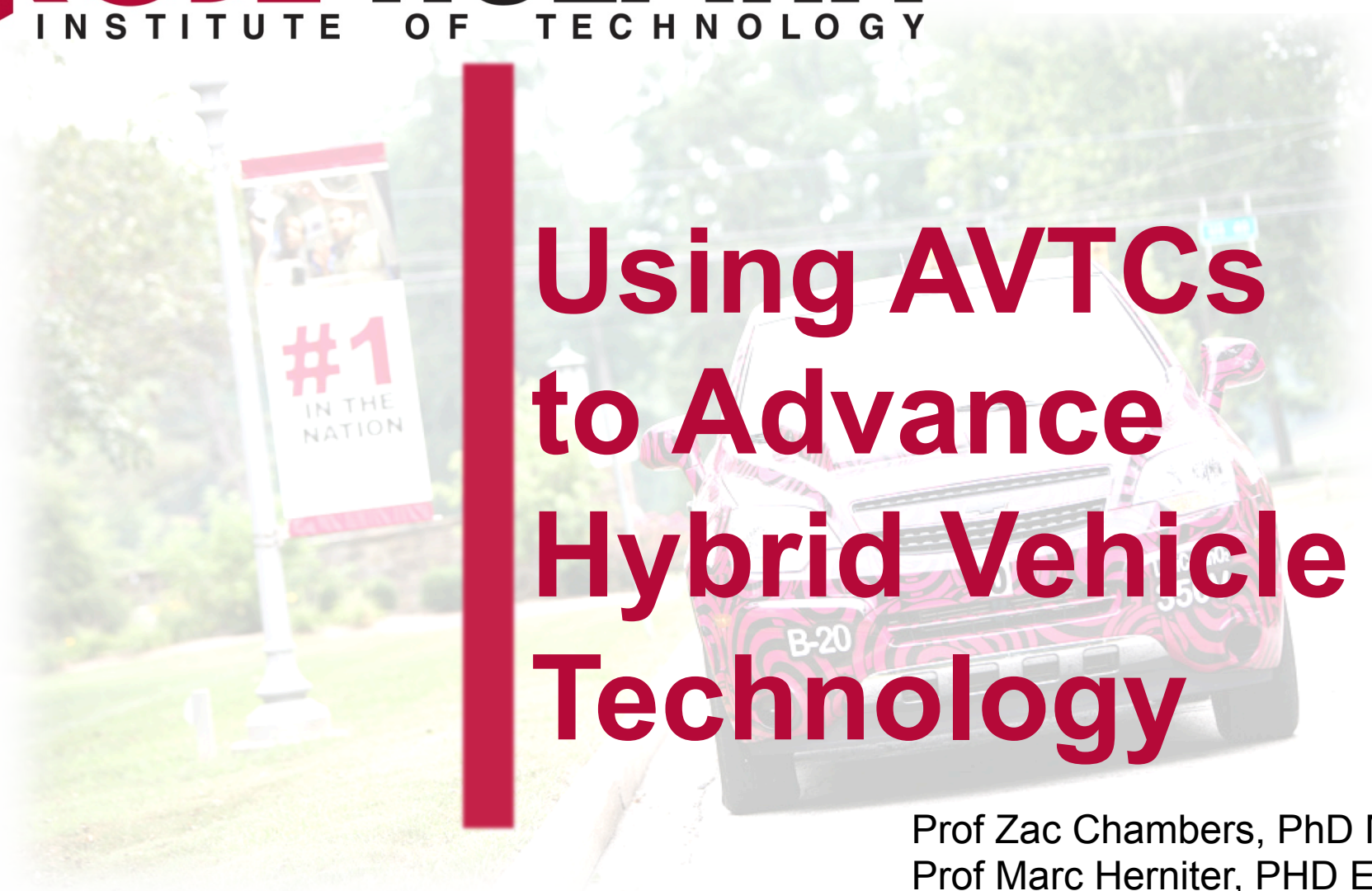


A background image showing a race car with a pink and black camouflage pattern, driving on a road. To the left of the car is a white signpost with a sign that reads '#1 IN THE NATION'. The text 'Using AVTCs to Advance Hybrid Vehicle Technology' is overlaid in large red font on the right side of the image.

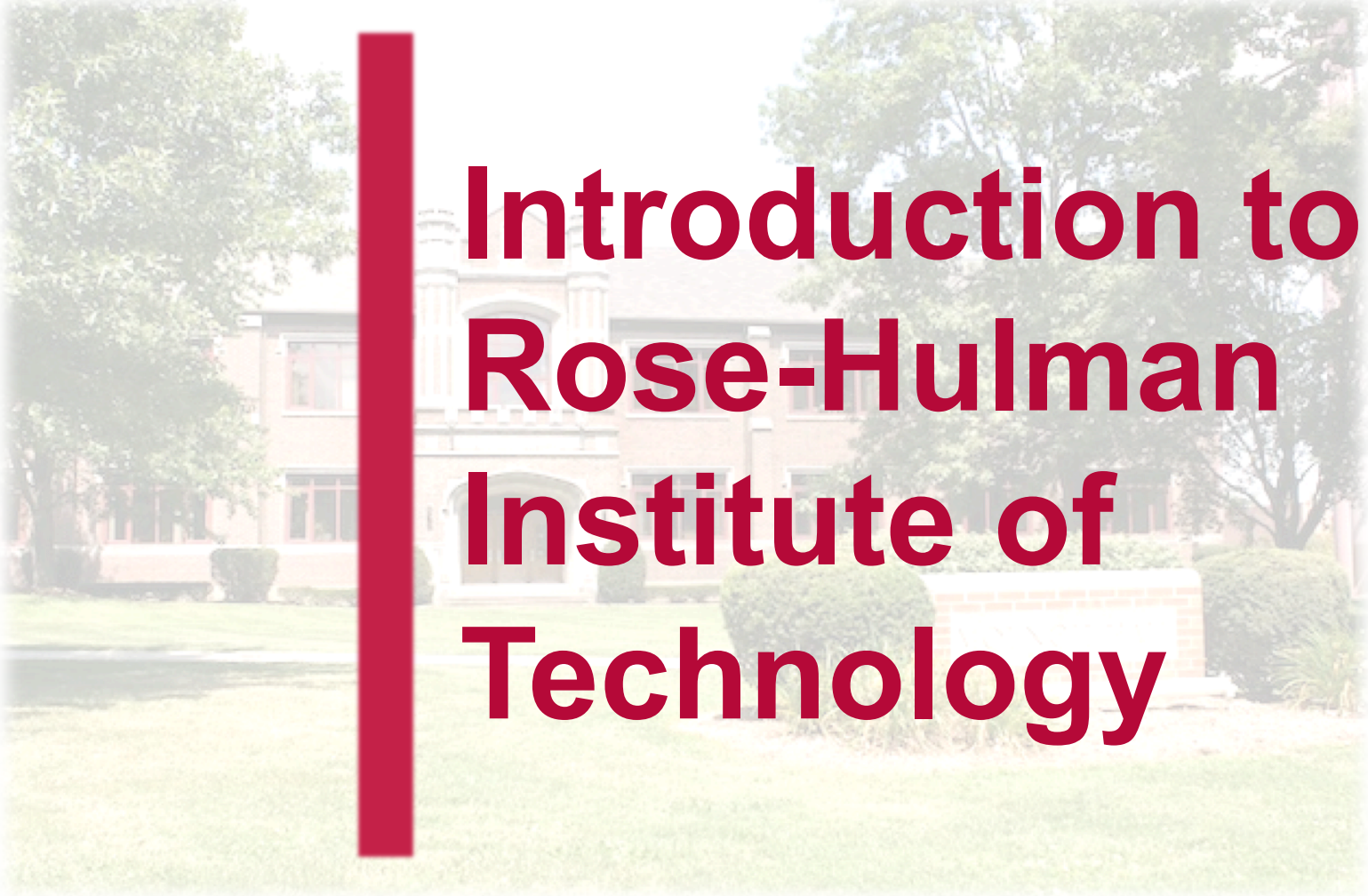
Using AVTCs to Advance Hybrid Vehicle Technology

Prof Zac Chambers, PhD ME
Prof Marc Herniter, PHD ECE

Outline

- Introduce Rose-Hulman
- Describe ATS Program
- Present AVTCs
- Conclude





Introduction to Rose-Hulman Institute of Technology



Our Legacy

- Founded in 1874 by Chauncey Rose
 - Railroad industrialist
 - Needed rail engineers
- The Terre Haute School of Industrial Science
- 1875 - Rose Polytechnic
- 1971 – Rose-Hulman Institute of Technology
- 2000 – U.S. News #1 Ranking



Academic Themes

- Academic Excellence
- Students Come First
- Faculty Who Teach
- Engaging Culture
- Co-Curricular Activities



Numbers

- Total Enrollment 1888
- Average Class Size 20
- Academic Majors 16
- Median SAT Score 1320
- Internships 85%
- Placement Rate 96%
- Average Salary \$59,636

10% enter Advanced Transportation Sector



Advanced Transportation Systems Program



Mission

- *To be the world leader in producing undergraduate engineers uniquely qualified to be immediate producers and rapid risers in the Advanced Transportation sector.*



Why Rose-Hulman?

- Top undergraduate engineering college for 14 years in a row
- Eight of top 10 employers are Advanced Transportation
 - Caterpillar, Chrysler, Cummins, Ford, GM, NAVSEA Crane, Rockwell-Collins, Rolls-Royce
- Rich Indiana automotive heritage
- Indiana encouraging advanced transportation industry



Student Innovation Center



Competition Teams

EcoCAR2



Rose Efficient Vehicle



Team Rose Motorsports



Human Powered Vehicle



Design Build Fly



Gran Prix Engineering



Team Highlights

- HPV
– Won 8 of last 10 national competitions
– Hosted the 2010 East Coast Competition at IMS
– Implementing an electric drive
- GPE (FSAE)
– Third year of competition
– 15th place last year
– Hoping to compete in Italian event hosted by Dallara



Team Highlights

- RHEV
 - Three top 3 finishes in Shell EcoMarathon
 - Routinely get over 1,800 mpg
 - Implemented overall powertrain controller
- EcoCAR2
 - Nine top 3 finishes in MBSD, ES, and VI
 - Designed and deployed two hybrid vehicles
 - Current vehicle is 350 hp Eco^{sport} sedan





AVTCs



AVTCs

- Since 1989 the US Dept of Energy has been sponsoring AVTCs
 - Decrease petroleum consumption
 - Decrease emissions production
- Programs co-sponsored by Ford, Chrysler, and GM
- Organized by Argonne National Labs
- A range of fuels were investigated for the first 11 years.
- In 2000 FutureTruck moved into hybrids



AVTCs



1989 Methanol
Natural Gas

1993 Methanol
Natural Gas

1995 FutureCar
Propane
Ethanol

2000 FutureTruck

FutureTruck 2004 ChallengeX 2008

EcoCAR 2011

EcoCAR2



Hybrid AVTCs

- Unique invitation-only competitions
 - 15 North American colleges and universities
 - Three year design, build, validate programs
 - Decrease fuel consumption and emissions production on Well-to-Wheels basis
 - Minimal sacrifice in performance, safety and utility
 - Significant funding: \$32million for EcoCAR2!



Hybrid AVTCs

- Architectures
 - Parallel
 - Series
 - Powersplit
 - Fuel Cell
- Fuels
 - E10
 - E85
 - B20
 - Hydrogen



AVTCs

- 91 colleges and universities have been selected
- 515 yearly teams have participated
- Approximately 11,600 students have been involved
- In 2005, 76% of students went into automotive field
- In 2010, X% of students followed suit



Innovation

- Rigorous MBSD approach using MIL, SIL, and HIL
- NX integration of all subsystems into full CAD of vehicle
- NASTRAN FEA analysis for all modifications
- Battery design and deployment
- HV system analysis and implementation
- Technical publications

Building a production quality hybrid in 3 years



Conclusion



Innovation

- The product is the students!
- These are the people that you want to hire!
- These are the teams you want your name in front of!
- This is the program you want to be a part of!



The Teams

- Cal State LA
- Colorado State
- Embry-Riddle
- Mississippi State
- North Carolina State University
- Ohio State University
- Penn State University
- Purdue University
- Rose-Hulman Institute of Technology
- University of Tennessee, Knoxville
- University of Victoria
- University of Washington
- University of Waterloo
- Virginia Tech
- Wayne State University



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