IPRO 342

TITLE: HYBRID ELECTRIC VEHICLES: SIMULATION, DESIGN AND IMPLEMENTATION

SPRING 2006

PROJECT PLAN

Objectives

IPRO 342 aims to complete the conversion of a CTA bus and a school bus from conventional vehicles to hybrid. There will be one retrofit parallel design for the CTA bus, while for the school bus there will be a new and a retrofit parallel design. All vehicle simulations and structured testing will be performed using ADVISOR, as well as other software packages available in the Power Electronics and Motor Drives Laboratory at IIT. Designed heavy-duty vehicles will be simulated and their performance as well as fuel economy and emissions under different conditions will be studied.

Background

Increasing use of electrical power to drive automobile subsystems, which historically have been driven by a combination of mechanical, hydraulic, pneumatic, and electrical power transfer systems, is seen as a dominant trend in advanced automotive power systems. This is the concept of More Electric Cars (MEC). The need for improvement in comfort, convenience, entertainment, safety, security, and communications is already providing the impetus to improve the performance of automobiles and their reliability. As a result, the MEC concept is seen as the direction of automotive technology. The most practical and promising solution feasible for the automotive industry to achieve very high fuel economy and very low emissions through the MEC concept is Hybrid Electric Vehicles (HEV) technology. Hybrid electric vehicles have electric propulsion system(s) other than the conventional ICE (Internal Combustion Engine).

Methodology

The team will approach this project by conducting a detailed research on hybrid vehicles that are in the market. Then systematic testing of parallel configurations will be done using ADVISOR. The structured testing will be used to determine the hybridization factor for each individual bus configuration. Research of mechanical drive train designs for buses will also be conducted to achieve the best possible method of integrating the motor and energy storage units into the bus drive train. Finally, a cost analysis of hybridization will be conducted.

Expected Results

Our goal is to accomplish the simulations, designs, and implementations of a hybrid CTA bus and a school bus. The optimal hybridization factors will be based upon maximum performance and fuel efficiency. This will give estimates of cost of hybridization based on recommendations of optimal components.

Budget

There is no plan budget for this project because the team is not performing the actual conversion of either bus. The only expenses are associated with the construction of the professional poster.

IPRO 342 Teams

CTA Bus Team:
Ana Martin (EE, 4th year) – Leader
Shameek Ghosh (Grad)
Robert Fleming (ME,)
Dan Lolwaczny (AE)
Jae Suk Lee (EE)
Alexander Warner (EE, 2nd year)
Dipti Sharadendu (EE, 2nd year)

School Bus Team:
Pradeep Shenoy (EE, 3rd year) – Leader
Jasmine Vadgaama (Grad)
Kevin Locascio (AE)
Jose Hernandez (AE)
Taekmin Oh (EE)
Priscilla Mulhall (EE, 2nd year)
Sapna Patel (MBB, 2nd year)

Instructor: Sheldon S. Williamson

Timeline and Responsibilities

- General Research – By Thursday, Feb. 2. (all)
- Introductory Website – By Thursday, Feb. 16. (Jasmine and Shameek)
- ADVISOR Simulations – By Thursday, Feb. 23. (Lee and Taekmin)
- Electric Drive Train Simulations/Power Electronics – By Tuesday, Feb 28. (Jasmine and Shameek)
- Mechanical Configuration Initial Design – Tuesday, Feb 28. (Rob & Dan for CTA bus, Jose and Kevin for school bus)
- Batteries/Motors – Thursday, March 2. (Ana and Dipti for CTA bus, Deep for school bus)
- Initial Cost Analysis with vendor details – Thursday, March 23. (Alex and Dipti for CTA bus, Priscilla and Deep for school bus)
- Final Designs and Cost Analysis – Tuesday, April 18.

Deliverables

- **Project Plan – Due: Friday, Feb. 3.** (Ana and Deep)
- **Mid-Term Report – Due: Friday, March 10.** (Dipti, Ana, Deep)
- Professional Exhibit – For teams that create a large format poster, if it is to be printed through the IPRO Office, the electronic file, in PDF or GIF format on a CD, is due: **Friday, April 28**.
- One Page Abstract – The electronic MS Word file for the abstract, if it is to be printed by the IPRO Program Office, is due: **Monday, May 1**.
- Final Website – For teams that create a web site, the URL must be provided to IPRO Office by **Friday, April 28** and must be ready for judging at **12:00 noon Wednesday, May 3**. (Jasmine and Shameek)
- Final Oral Presentation – PowerPoint Presentation is due: **Wednesday, May 3**.
- Final Project Report – Due: **Friday, May 5**.

- Team Information – Continuous process, with final completion by: **Friday, May 5**.
- Comprehensive Deliverables CD – Due: **Friday, May 5**.
- IPRO Team Debriefing – **Week of May 8** during each team's standard two-hour finals time slot.