
PROJECT PLAN

I PRO 326 – Fall 2004
Hybrid Electric Vehicles: Simulation, Design, and Implementation

Submission Date: September 10, 2003
Team Members: Marta Bastrzyk, Thomas Hittie,
Theresa Hudik, Chad Johnson, Mahdi Mohammad,
Ali Naqvi, Paul Reinhard, Sadia Sadiq, Jeffrey Stano,
Gregory Waliczek, and Tiana Washington

Objectives

The IPRO 326 Project aims at systematically testing both parallel and series vehicle configurations of the Hummer and HMMWV (High-Mobility Multipurpose Wheeled Vehicle) to find the optimum hybridization factor specific to each configuration. An additional objective of the team is to work in coordination with Ph.D. students to simulate a hybrid electric bus system that is scheduled to have practical implementations by the end of the year. The team will also review research papers published from other universities to prepare for the upcoming FutureTruck 2005 competition, which involves designing more energy-efficient trucks with hybrid-electric drive trains. 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. Related work done by previous student teams shall be reviewed and integrated into this project.

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). Design characteristics will be provided to the students at the beginning of this project based on practical models from leading automobile companies such as GM, Ford, Toyota, Honda, and Nissan.

Methodology

The team will approach its primary objective by systematically testing parallel and series configurations of the Hummer and HMMWV vehicles using ADVISOR. The structured testing will be used to determine the optimal hybridization factor for each individual vehicle configuration. For example, the hybridization factor of the HMMWV vehicle can be determined by repeatedly testing the power out of an electric motor from 0 to 100 kW. As for the hybrid electric bus simulations, ADVISOR will once again be heavily used. Research of mechanical drive train designs for buses will also be done to achieve the best possible method of integrating the motor into the bus drive train. Finally, various research papers done by other universities will be reviewed for the FutureTruck competition, with the goal to devise the best possible hybrid drive train mechanical design for trucks and hybrid electric sport utility vehicles (SUVs).

Expected Results

The expected results will mainly come from detailed hybrid electric automobile simulations. These will allow the prediction of vehicle performances, voltage source recommendations, and most importantly, the hybridization factors for the individual vehicle configurations. Another important aspect is the fulfillment of street legal stipulations. This IPRO is one of the pioneers into the hybridization of a vehicle, hence launching the possibility to find sponsors and companies interested in financing this promising project. This task of finding financial help is a part of our goal. For the long-term plan of

developing “IIT’s Hybrid Electric Car,” this IPRO will provide design guidelines, as well as technical and possible financial support.

Schedule of Tasks

In addition to the weekly IPRO meetings, the technical team members will meet once a week with their individual objective-oriented sub-teams to conduct research and testing pertaining to their chosen objective. Technical issues will be studied in detail at that time. The team leader of each sub-team will be responsible for reporting progress and concerns to the project team leader, as well as contacting potential sponsors for the project.

Budget

At this period in time there is no planned budget for this project because the vast majority of the research material related to this project has already been obtained. Other expenses should be limited to the expense associated with the construction of the professional poster and the final presentation.

Deliverables

Project Plan	September 10
Team Website (Introductory/Mid/Final).....	Sept. 30/Oct. 22/Dec. 1
ADVISOR Simulations (Mid/Final)	October 22/November 29
Mid-Term Progress Report (Final)	October 22
One-Page Abstract (Final)	November 29
Final Oral Presentation (Final).....	December 1
Professional Exhibit (Final)	November 29
Team Minutes & Interprofessional Perspectives (Final).....	December 3
Team Member Journal (Final)	December 3
Team Log (Final)	December 3
Comprehensive Deliverables CD.....	December 3
Final Project Report (Final)	December 3
IPRO Debriefing Session.....	Between Dec. 6 and 13

Responsibilities

Marta Bastrzyk.....	ADVISOR Simulations for HMMWV (Series Configuration), ADVISOR Simulations for HUMMER (Series Configuration)
Thomas Hittie.....	ADVISOR Simulations for HUMMER (Parallel Configuration), ADVISOR Simulations for HMMWV (Parallel Configuration), Hybrid Drive Train Mechanical Design and Review for Future Truck Competition, Team Member Journal
Theresa Hudik.....	ADVISOR Simulations for HMMWV (Series Configuration), ADVISOR Simulations for HUMMER (Series Configuration), Team Member Journal, Poster

Chad Johnson.....ADVISOR Simulations for HUMMER (Parallel Configuration),
Website Construction

Mahdi Mohammad.....Hybrid Electric Bus Simulation and Mechanical Drive Train Design

Ali Naqvi.....Hybrid Electric Bus Simulation and Mechanical Drive Train Design,
Poster, Team Vice Leader

Paul Reinhard.....Technical Team Leader

Sadia Sadiq.....Project Plan, Abstract, Mid-Progress Report, Final Report, Team
Leader

Jeffrey Stano.....ADVISOR Simulations for HUMMER (Series Configuration),
ADVISOR Simulations for HMMWV (Series Configuration),
Hybrid Drive Train Mechanical Design and Review for FutureTruck
Competition

Gregory Waliczek.....ADVISOR Simulations for HMMWV (Series Configuration),
ADVISOR Simulations for HUMMER (Series Configuration),
Website Configuration

Tiana Washington.....ADVISOR Simulations for HMMWV (Parallel Configuration),
ADVISOR Simulations for HUMMER (Parallel Configuration),
Team Minutes