An Overview of the EEE- B.Tech final year projects in the academic year 2013-14

The 2010 B.Tech syllabus and regulations of MG University were implemented for the final year B.Tech projects in the academic year 2013-14. Instead of the one semester final year project in the old syllabus, the new syllabus stipulates the final year project to start in seventh semester and continue till the end of eighth semester. This gave the students enough time to plan and implement innovative and challenging projects.

The project topics were finalized by the students in the first month of seventh semester itself. The students were given the liberty to form groups themselves and choose any topic of their interest. Once the students finalise the topic they were asked to approach the faculty members to guide their projects. The abstract presentations were done by the student groups in front of an evaluation committee.

The project topics were as follows:

1. Speed Synchronization of Multiple Motors
2. Intelligent Cabin using RFID Technology
3. Remotely Operated Underwater Vehicle
4. Navigation system for the Visually Challenged
5. Magnetic Levitation Assisted Vertical Axis Wind Turbine
6. Self Balancing Robot(Inverted Pendulum Principle)
7. Remote controlled Multi-purpose Quadrotor
8. Solar mobile charger with irradiance Indicator
9. Fuzzy logic controlled industrial dehumidifier
10. An Intelligent Traffic Control Using RFID
11. On Line Electric Vehicle
12. Robotic Arm using Haptic Technology
13. Mind Controlled Robotic Arm
14. Home Automation using Arduino Microcontroller
15. Power Generation via Cardiac fitness

The work done by the students were continuously monitored by the project guide, By the end of seventh semester, an evaluation of the progress was made by the project coordinators and a report was submitted by each group. The project work continued to the eighth semester and there were two interim presentations in the eighth semester to evaluate the progress. The final evaluation of projects were conducted in the first week of April 2014 and the project reports were submitted by the project teams.

Since the students had almost 10 months to work on their projects, the overall quality of the projects were good. Therefore the students were encouraged to participate in intercollegiate project competitions to exhibit their project work. NAVA 2K14, a national level project expo and competition was held at M.A. College of Engineering, Kothamangalam on 27th March 2014. Eleven teams from EEE department participated in the event and RSET won the Special Achievement Award for the maximum participating teams. Among the participating teams, top three teams were shortlisted in EEE category. The projects shortlisted from the EEE category are:

1. Mind Controlled Robotic Arm
2. Remotely Operated Underwater Vehicle
3. Magnetic Levitation Assisted Vertical Axis Wind Turbine

Final Prototype

The project titled "Magnetic Levitation Assisted Vertical Axis Wind Turbine" won the first prize in the EEE category. (Prize Money: Rs. 15,000)

Project teams from EEE department also participated in the All Kerala Idea Presentation Contest 2014 held at RSET Cochin on on 05-Apr-2014 organized by IETE Students' Forum, RSET.

An exhibition of the final year projects was done on 8th April 2014. The following projects were adjudged as the best projects.

1. On Line Electric Vehicle (1st Prize)
2. Remotely Operated Underwater Vehicle
3. (2nd Prize).

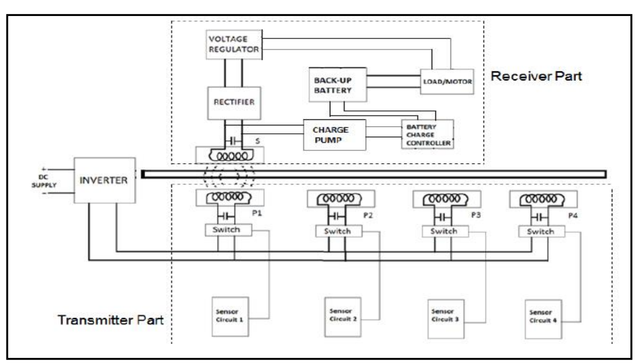
Think to Ponder

1. On-Line Electric Vehicle

The On-Line Electric Vehicle (OLEV) is an innovative electricity-powered transportation system which remotely picks up electricity from power transmitters buried underground. Most electric vehicles introduced so far use a battery as energy storage, from which the motor in the vehicle consumes the electric power and the battery is charged at a charging station refilling the energy. But, the amount of power that could be stored in the battery is limited and therefore, the electric car should be stopped at the charging station to refill the power more often.

A typical plug-in vehicle requires at least a couple of hour long charging time. The On-Line Electric Vehicle (OLEV) is a new concept of the electric transportation system to overcome the limitations of the current existing plug-in electric vehicles.

Online Electric Vehicle (OLEV) is an electric vehicle using electromagnetic induction. The system is based on a recharging road. The power transmitters - inductive coils buried under the roadway - generate a magnetic field to supply the vehicle with required energy. The power pick-up unit installed underneath the vehicle remotely collects electricity and distributes the power either to operate the motor in the vehicle or to charge the battery. Whether running or being stopped, the OLEV constantly receives electric power through the underground coils. As a result, the OLEV mitigates the burden of equipping electric vehicle with heavy and bulky batteries. The important feature is that only the coils under the vehicle gets energized turning other coils off, thus avoiding energy loss.



Block Diagram

This project presents the concept of the contactless power transfer system and this new electric vehicle, which draws its electric power from underground coils without any mechanical contact. OLEV's are considered to be safe and economic than plug-in cars, and looks to be a promising technology for a greener future.

Group members:

- Edwin Ignus Paul
- Johny Sebastian
- Shilpa T Dinesh
- Sruti Pious Chalil

Guide:

Mr. Unnikrishnan L

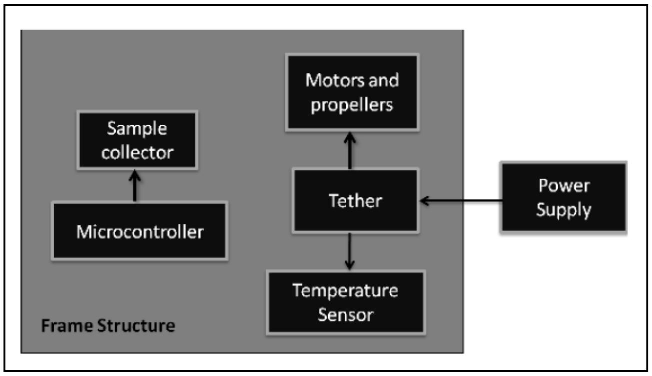
2.2 Remotely Operated Underwater Vehicle

Unmanned underwater vehicles (UUV), sometimes known as underwater drones, are any vehicles that are able to operate underwater without a human occupant. These vehicles may be divided into two categories, remotely operated underwater vehicles (ROVs), which are controlled by a remote human operator, and autonomous underwater vehicles (AUVs), which operate independently of direct human input.

Final Prototype

ROV is an underwater vehicle, linked to the ship or operator by either a neutrally buoyant tether or, often when working in rough conditions or in deeper water, a load carrying umbilical cable is used along with a tether management system (TMS).

The ROV that is designing for this project is controlled via a tether, by a controller above the water level. The payload essentially consists of a pressure sensor, depth sensor and a temperature sensor. The power, size, construction etc. of the ROV is determined by the weight and design of the payload. The data is collected from these equipments, and is sent back to the controller using the cables. The whole structure is encased in a watertight enclosure to ensure proper working.



Block Diagram

This project can be further expanded to include an underwater camera as well as other equipments in the payload such as water sample collector, silt remover, an arm to collect samples etc. These vehicles can be used to study the water beds in oceans, to remove oil spills, and for military applications. Again they can also be extended to be completely autonomous, i.e. requiring absolutely no controller.

Group members:

- Mamatha Agnes George,
- Meghna T Rajeev
- Tiza Varghese

Guide:

Ms. Ragam Rajagopal

2.3 HIGHER ORDER SLIDING MODE CONTROL

Since the sliding mode control (SMC) was invented in the beginning of the 1950s, SMC has developed into a general design method being examined for a wide spectrum of systems including nonlinear systems, uncertain systems, stochastic systems, and large-scale and infinite-dimensional systems.

Sliding mode control, or **SMC**, is a nonlinear control method that alters the dynamics of a nonlinear system by application of a discontinuous control signal that forces the system to "slide" along a cross-section of the system's normal behavior. The state-feedback control law is not a continuous function of time. Instead, it can switch from one continuous structure to another based on the current position in the state space. Hence, sliding mode control is a variable structure control method. Having proved their higher accuracy and robustness with respect to various internal and external disturbances they also reveal their main drawback: the so called chattering effect which is dangerous high frequency vibration. To avoid chattering many approaches have been proposed. The main idea is to change the dynamics in the small vicinity of the sliding surface. However in this case the main robustness and accuracy of the sliding mode is partially compromised.

High-Order Sliding Mode (HOSM) control was originally proposed to overcome the dangerous chattering effect. The idea is to treat the time derivative of the actual control as a new control artificially raising the relative degree of the sliding variable. The resulting HOSM features finite-time stability, ultimate accuracy of sliding mode, and smooth control. Unfortunately, due to the interaction between the control and its derivative, the convergence to the HOSM is only ensured, if the initial values of the successive sliding-variable derivatives are small enough.

High order sliding mode (HOSM) actually is a movement on a discontinuity set of a dynamic system understood in Filippov's sense. The sliding order characterizes the dynamics smoothness degree in the vicinity of the sliding mode. Consider a smooth dynamic system with a smooth output function s. The function s can for example be a tracking error. The task is to make s vanish, keeping it at zero afterwards. Successively differentiating s along trajectories, a discontinuity will be encountered sooner or later.

One of the main results of the HOSM theory is that a number of predefined standard controllers are developed, defined for each given relative degree r, which solve the problem of keeping s = 0 in finite time. Such controllers are called r-sliding controllers and actually require only the knowledge of the system relative degree r.

HOSMs were historically created to remove the chattering effect. The idea is to consider the kth-order time derivative of the actual control as the new control input. As a result, the relative degree raises, and a new (r + k) sliding controller is applied, corresponding to the new relative degree r + k. Simulation results show that produced (r + k)-sliding dynamics is robust with respect to the influence of unaccounted-for small noises, delays, fast stable actuators and sensors. Moreover, it was proved that the dangerous chattering effect is removed, and only negligibly small vibrations of infinitesimal energy persist.

2.4 FLUX OBSERVER BASED SENSORLESS CONTROL OF THREE PHASE BLDC MOTOR DRIVE

The brushless DC motor is used in both consumer and industrial applications due to its compact size, controllability and high efficiency. BLDC motors are usually operated with one or more position sensors, since the excitation must be synchronous with the rotor position. For reasons of cost reduction, reliability and mechanical packaging it is desirable to run the motor without position sensors – the so called sensorless operation.

Several sensorless control schemes have been introduced for PMBLDC motors in the last few decades. Of these, the most popular one is the back emf based control method. In this scheme, the rotor position is sensed indirectly by examining the zero crossing detection of the terminal voltages of un-energized phase. Another control method is using Extended Kalman Filter (EKF).

Flux Linkage Observer (FLO) based sensorless method utilizes the rotor flux information to estimate the rotor position. The only two inputs to the observer are the machine voltages and currents. Using system equations, the rotor flux linkages are estimated in the α-β reference frame. Using 'atan2' function, the instantaneous rotor position is estimated. Speed can be calculated from the estimated rotor position by differentiation. But this will result in significant noise. This can be avoided by using a PLL structure to obtain the motor speed. The error between the estimated rotor position and its previous value is fed to the PLL. A PI controller is used to process this error and estimate the speed. Since at low speeds flux cannot be determined, a starting method must be adopted. The control method is validated using simulation results done in MATLAB/Simulink on a 24V, 4000rpm PMBLDC motor. Figs. (1) & (2) illustrates the dynamic response of the drive to step change in speed & load torque respectively.

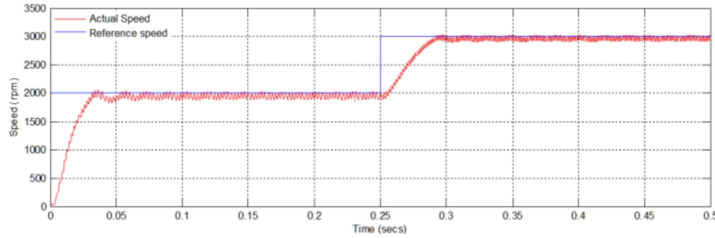


Fig.1 Drive response to change in reference speed from 2000rpm to 3000 rpm

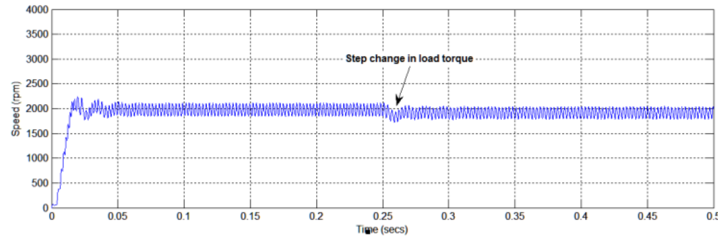


Fig.2 Drive response to change in reference change in load torque from no load to 0.125Nm

The main advantage of flux observer is the ease of calculation of rotor position and speed. But this method depends on machine parameters. It was observed from the simulation results that, as the speed approaches its rated value, the range of torque control reduces.

An Overview of the EEE- B.Tech final year projects in the academic year 2013-14

Students will acquire the broad education necessary to understand the impact of engineering solutions on individuals, organizations and society. Students will be able to

>>Acquire new knowledge in the Electrical Engineering discipline and to engage in lifelong learning.

>>Use the skills in modern Electrical Engineering tools, softwares and equipment to analyze and model complex engineering activities.

>>Acquire the knowledge in management principles to estimate the requirements and manage projects in multidisciplinary environments