Dipti Bawa Fuzzy control based solar tracker using Arduino Uno

The need of electrical energy is increasing in our day to day lives but since the resources are limited there is requirement of increasing the production of energy through alternative/ renewable sources. Today solar energy is viewed as a clean and sophisticated source of power generation which has increased the use of photovoltaic systems in many applications. Despite of solar energy being a good source of energy, there is a need to improve the methods to harness this energy. This can be achieved by maximum power point tracking and axial tracking. These methods require very efficient controllers for their implementation. The controllers are mainly based on the conventional methods like P&O, hill climbing etc. and the relatively new and intelligent approach like Fuzzy control, Neural networks etc.

In this project a solar tracking system has been designed and implemented using fuzzy control. The system consists of two modules: Maximum Power Point Tracking (MPPT) using DC-DC Converter in buck configuration which is used to charge a battery system and secondly single axis tracking using a stepper motor and Arduino Uno. MPPT has been implemented on Arduino Uno to control the on/off time of MOSFET switch of the DC-DC converter. The stepper motor helps in tracking the axis of the sun and keeps the panel in the direction of the sun all day long. The proposed fuzzy logic controller has been implemented and tested using MATLAB. The above sun tracking power generation system has been tested in real time. This system increases the energy generation efficiency of the solar cells.

RAHUL NARAYAN BENDALE DESIGN AND HARDWARE IMPLEMENTATION OF MODEL FOLLOWING SLIDING MODE CONTROL WITH ITS APPLICATION

Modern control laws almost invariably require all the states of the system for feedback. Sliding mode control is used in many applications in order to make the system behaviour independent of the uncertainties in system parameters and external disturbances. The problem of estimating the states is complicated when the system are a elected by significant uncertainties and unmeasurable external disturbances. The main objective of this dissertation to design model following sliding mode control for uncertain systems,where error states are forced to slide along chosen manifold. Conditions are stated that should satisfy for the design of control. In this dissertation the model following controller is designed using sliding mode control and augmented with uncertainty and disturbance estimator. Di erent sliding surface are selected and accordingly model following controller based on SMC is designed and the results of each strategy are analysed. The developed strategies are then simulated and implemented on DC motor platform. Model is chosen such that the additional matching conditions are satisfied while implementing it on hardware. Lastly developed strategies are extended to the control problem of tank gun system. The simulation results are presented for the same. A suitable model is chosen such that the tank gun system will follow it faithfully.

Bharati Swapnil Shivdatta Virtual Instrumentation Based Electronic Tongue for Detection of Amylose Content in Rice

In India rice is major staple food, also many food products are made from rice or its poor. Nowadays people are dietary cautious about food contains and its quality parameters. In case rice amylose contents is good quality parameter. Amylose contents decide digestion time which predicts the absorption of glucose in blood. So, diabetic patients are suggested to use high amylose content rice. Detection of amylose contents in rice needs attention as a part of dietary as well as selection for rice for a typical application. Qualitative analysis of rice to detect amylose contents becomes motivation. Many dierent methods are used for checking amylose contents like NIR spectroscopy, colorimetry, and latest cyclic voltammetry. In amylose-iodine colorimetry, a standard color chart was used instead of a spectrophotometer to successfully classify a wide range of cultivars with known and unknown amylose content. Near-IR spectroscopy can also be used to measure the amylose contents. As an alternative method, voltametric electronic tongue can be used for classification of amylose contents in rice. The interest in electronic tongue applications has grown enormously in recent years for recognition and quality analysis of various food and agro products. All current methods/techniques of amylose detection require a typical experimental setup. Amylose content is predicted corresponding to output values of setup. To overcome the requirement of experimental setup, a virtual instrumentation based (NI-LabVIEW) user interface is used for the prediction of amylose contents. The user interface provides a platform to compare results for difierent methods of checking. The graphs are plotted using the di erent experimental setups and comparing it with standard laboratory readings. The virtual instrumentation interface provides soft sensing of the amylose contents in absence of experimental set ups.

Tejaswinee J. Darure Design and Implementation of Advanced Control Strategies for Boiler and Heat Exchanger Pilot Plant

The demands for rapid changes in power generation is increasing. This leads to more stringent requirements on the control systems for the processes. Boiler is drawing significant attention in community of process control and instrumentation, as far as its eficiency and control is concerned.In this perspective, pilot plant of boiler is operated using many control ends with variety of control strategies so that resultant solution can be practically implemented to industrial unit operations. Experimentation is carried on pilot plant of Electrical Boiler and pipe in pipe type counter current heat exchanger to test better controllablility. Both pilot type unit operations are available after undergoing tedious commissioning and erectioing procedures of installation. During this period,installation,calibration and testing for all transmitters and actuators are completed as rst phase.Multiple control ends are achieved by making a system available to programming logic controllers, distributed control system as well as to simulation softwares. The networking of controlling a single plant through these many controllers started from the basics of MODBUS and Ethernet IP protocols and then their configuration in local

controllers, their hardware requirements are accomplished. During these assignments, challenges regarding hardware capacities, constrained resources are handled with the help of guidance of experienced industrialist and discussion forums.Thus we can have a comparative study of all controller ends and solution for better efficiency for both unit operations, which is applicable to industry grade operations. Under the project of Virtual Labs (funded by MHRD), java compilers are developed where pilot plants are controlled using user friendly frontends. These frontends exchange data using MODBUS protocol which is tested thoroughly on serial port monitoring softwares. The functional blocks for programmable logic controller (PLC) and distributed control system (DCS) are designed and tested rigrously.Thus one more additional control end is available with pilot plant to undergo with various control strategies and making them available to comparative studies with industry developed controllers. Thus student has the bene t of experimenting dierent control strategies on a single plant with PLC,DCS, MATLAB as well as virtual PLC and DCS with local controllers without any compromise in safety . A provision for observing and logging data for passive master controllers is also available so that other students who are not performing experiments can observe active master and obtain data and can to accomplish assignments of data based modeling, system identification etc. This kind of facility is a definite add on for students to educate themselves and enhance their abilities to sustain and grow in professional world outside.

DEBI PRASAD DASH Design and Simulation of Fuzzy Adaptive Controller for Heat Exchanger

Shell and tube heat exchanger system is widely used in chemical plants because it can sustain wide range of temperature and pressure. The main purpose of a heat exchanger system is to transfer heat from a hot fluid to a cooler fluid, so temperature control of outlet fluid is of prime importance. I have designed fuzzy logic controller and fuzzy adaptive controller for shell and tube heat exchanger system, uses MATLAB as a visual modeling tool and simulation research based on Simulink. The purpose of these controllers is to maintain a uniform temperature at the output of the heat exchanger system, there by varying the input flow rate. The control action taken by the fuzzy logic controller is based on the deviation from set point i.e. error and rate of change of error. In the design of adaptive control, model reference adaptive control scheme is used.The designed controllers for the heat exchanger system is then compared with a conventional PID controller. The result shows that fuzzy adaptive controller has less overshoot and settling time than conventional PID controller and fuzzy logic controller.

Suraj Gautam Measurement Noise with Inertial Delay Controller and Inertial Delay Observer

To Implement SMC, all the states of the system are required.In Conventional SMC, chattering are the main problem due to high frequencies components used in controller and can be eliminated by inertial delay controller with SMC. But practically all sensor reading are corrupted by noise by some degree or measurement noise always present in the system. When noise enter the sensor,the states of the plant cannot be preciously measure. its create unwanted chattering in controller as noisy states are used in control designing. So filtering of states are necessary to overcome chattering. Measurement Noise also effect observer states. The main objective of this dissertation is

1. Reaching phase elimination methods
2. To Implement Inertial delay control with measurement noise on QET DC motor
3. To Implement inertial delay observer with measurement noise on QET DC motor

In this dissertation Reaching phase elimination using Translation method,full order surface and noval surface methods are derived and varify through simulation results.
Inertial delay controller wih measurement noise using fal filter feedback structure, low pass filter are implemented on QET DC motor and Improvement using fal filter feedback structure are verify. The controller based on inertial delay observer are implemented on QET DC motor. Result are compared using fal filter feedback structure and without fal filter feedback structure.

Hemant S. Ghuge Design and Implementation of Advance Control Strategies for Evaporator Pilot Plant

Process control, design and optimization are the key features of any industry and continue to improve because of highly increasing global competition. Every industry is keen to increase their yield with minimum possible resources and money. Pilot plant plays a vital role in analyzing the effect of variables at various process conditions and for optimal study of the process.
Evaporators are used to concentrate fruit juices, caustic soda, milk and many other mixtures of a solvent and a solute, this unit operation is achieved by vaporizing part of the solvent to produce a concentrated solution, most evaporation operations used by industry use water as the solvent. The incentive for modeling such unit operations is that the model can provide insight towards better operating procedures or future design alternatives.
The main aim of this work is to design, develop and implement the lab scale pilot plant "Forced Circulation Evaporator". This pilot plant is used to perform rigorous experimentation for validation of theoretical results on actual system. Study and analysis of process and control aspects is done through a comparative study by operating plant through 5 different modes i.e. Local PLC, Remote PLC, Remote DCS, through MATLAB and from Remote Triggering over the Internet. The analysis tends to optimal operating conditions depending upon the various process parameters.
The major part of the process is of communication as one Plant is being controlled from various controller platforms operating on different Protocols.
The project work covered the process from concept to commissioning. It comprised of the fundamental building blocks viz. finalization of problem statement, concept building, designing the Process flow diagram, process calculations, P & ID, Instrument Index Sheet, designing the control philosophy, periodic

review, communication and active Interaction with various vendors for successful commissioning with necessary modifications.

Dhiraj Shrimantappa Marale Two Wheel Balancing Robot Using FPGA

Two wheel balancing robot is based on inverted pendulum configuration which rely upon dynamic balancing systems for balancing and manoeuvring. Aim of the project is to stabilize the robot such that the position of the platform is controlled quickly and accurately and the robot is always maintained tightly in its inverted position during movements. This project demonstrates the field programmable gate array (FPGA) implementation of a Balancing robot as a platform for the implementation of both control and sensor fusion algorithms. The system is highly unstable as it tends to tilt either way due to shift in centre of gravity. Accelerometer is used to measure the tilt and comparing both results, the voltage so obtained is given to analog to digital converter (ADC) of the FPGA. DC motors are interfaced with Spartan 3E kit via H Bridge and Programming is done such that, motors moves in the direction in which robot is falling by sensing output of ADC, so that robot can be balanced. The values from the tilt sensor are fed into the FPGA where control is implemented. Overall system demonstrates the use of low cost inertial sensors to balance a two wheeled robot. The system at present is able to balance on its own. The complete system stands as a base platform for more complex control and sensor fusion techniques in self balancing robots. Segway Robots uses the same principle for their operation.

Amitkumar B. Moradiya Design and Implementation of Sliding Mode Controller and Observer for Flexible Joint

Modern control laws almost invariably require all the states of the system for feedback. In practical systems all the states may accessible or the cost of sensors can be very high. In such situation the control laws can be made implementable by estimating the states from the available measurements. The problem of estimating the states is complicated when the system are a ected by significant uncertainties and un-measurable external disturbances. In the literature a variety of solutions has been given to solve this problem. In this dissertation observers were designed using the luenberger observer, Extended State Observer and Generalised Extended State Observer for Flexible Joint system. Different observer-controller combinations were tested in Matlab simulation environment. The stability of observer-controller combination is proved.

Conventional observers are based on an accurate mathematical model of the plant. But, accurate model may not be available in the real world application. The Extended State Observer (ESO) is partially model-independent observer. It has been successfully applied to man practical applications: such as DC-DC converters, and industrial servo systems. ESO is only applicable for SISO integral system with matched uncertainty. It is noticed that systems with non-integral-chain form and mismatched uncertainties are more general and widely exist in practical engineering systems. For such system, GESOBS can be used to overcome the drawbacks of ESO.ESO and GESOBC are also estimates the uncertainty in the plant accurately.

This research focuses on the comparative study of different observers and other control strategies like state feedback and Sliding Mode Controller. The purpose is to and a set of practical solutions that make control design and tuning easy and effective. The simulation and experimental results of motion systems of Flexible Joint show that GESOBS has a better overall performance. Active disturbance rejection control is an ESO- based control strategy. Linear ADRC achieves effective results when dealing with large inertia, friction variations and torque disturbance.

Pandit Vivek Vijay Design and implementation of advanced process control Strategies for Distillation column and Bio-reactor

Process industries add value to materials by mixing, separating, forming or chemical reactions. Processes may be either continuous or batch and usually require rigid process control and high capital investment. The developments in automation, and the resulting complexity of the systems involved, have made the reliability of the machines even more important. This is especially true in the process industry, characterized by expensive specialized equipment and stringent environmental considerations; therefore the need for a good process design and control system is obvious. A pilot plant is a small industrial system which is operated to generate information about the behaviour of the system for use in design of larger facilities. Pilot plants are used to reduce the risk associated with construction of large process plants. They do this in two ways, they are substantially less expensive to build than full-scale plants and they provide valuable data for design of the full-scale plant.

Distillation is a very old technique used for separation. Thermodynamics is the driving principle for distillation and by adding and removing heat, separation of liquids is obtained. Before industrialisation, distillation was a batch process used for making beverages and alcohol. A bioreactor is a vessel in which a chemical process is carried out which involves organisms or biochemically active substances derived from such organisms. This process can either be aerobic or anaerobic. A bioreactor may also refer to a device or system meant to grow cells or tissues in the context of cell culture. In Bioreactor fermentation process is carried to make products such as bread, cheese, beer and wine.

The main objective of this work is to design, develop and deploy the lab-scale pilot plant of Distillation Column and Fed-Batch Bioreactor/Fermenter for laboratory practical purposes, do modelling, perform experiments on the setup, apply suitable control strategies for the process control and analyse and validate the results on actual hardware. The analysis and validation of process and control aspects is done through a relative study by operating plant in five different modes i.e. Local PLC, Remote PLC, Remote DCS, through Mat Lab and from Remote Triggering. The very important aspect in operating the plant in different mode is communication as single plant is controlled by different platform having different protocols. A Laboratory pilot plant implementation will deliver exceptional value to a process manufacturing facility, automates the production of information from this data and effectively communicates with the other critical systems throughout the enterprise

The project work covered the process from concept to commissioning. It comprised of the fundamental building blocks viz. finalization of problem statement, concept building, designing the Process flow diagram, process calculations, P & ID, Tender Documents, Instrument Index Sheet, Specifications, Plant and Equipment layout, designing the control philosophy, periodic review, Erection and Commissioning, Soft Trail and at last Product Trail.

Mayuresh B Patil Multiple Surface Sliding Mode Control for Mismatched Systems with Inertial Delay Control

Many practical systems are under the influence of mismatched uncertainties/disturbances. These disturbances can be external or internal, generated due to non-linearity present in the system. These disturbances need to be estimated and eliminated so as to get desired response and stop the deterioration of the components. The main objective of this dissertation is to design the control strategy for such uncertain systems and estimate the unmatced disturbances came across. In the literature, a variety of solutions has been given to solve this problem. In this dissertation, controllers are designed using Sliding Mode Control (SMC) and Integral Sliding Mode Control (I-SMC). The controllers were tried on actual laboratory hardware. Disturbance Observer based Sliding Mode Control (DOB-SMC) promises desired output, overcoming the drawbacks of chattering and recovering the nominal performance of the system in the absense of the unmatched disturbances. Simulation and Hardware implementation on SRV02 plant very the advantages of this strategy. Apart from these control strategies reported in the literature, a new strategy is developed in this dissertation. It is developed using Multiple Surface Sliding Control (MSSC) and Inertial Delay Control (IDC) for estimation of unmatched disturbances which works for time-varying as well as state dependent unmatched disturbances. MSSC gives the desired output though the sensor noise or measurement noise is considered. The stability of the proposed strategy is also proved in the derivation. The results are very by simulation on the ball and beam system.

Ajinkya H. Patil Controller for Mismatched and Uncertain Systems using Backstepping Technique

The dynamic system model uncertainty is usually considered as the difference between real performance and nominal performance. The deviation (uncertainty) can arise both in static and dynamic system qualities. Mathematically, the uncertainties can be described by variations of system coeficients within certain intervals around the coefficients of the nominal model. Hence control of such systems Also the unavailability of states makes the task of designing control for the system makes it more complex and complicated. The main objective of this dissertation is to design controller using backstepping technique, along with the use of state and disturbance observer to help deign the control. When a system fails to satisfy the matching conditions, design of control for that system becomes a daunting task. For such systems, a backstepping controller can be designed which uses estimates of state and as well as disturbance for generation of control signal. This dissertation also provides with improvement over the control designed using nonlinear adaptive controller,where the problem is treated as problem with presence of unmatched or matched disturbance. These developed strategies are then implemented on DC Motor hardware. Also in this dissertation, control strategy for control of systems with mismatched and matched uncertainty is also presented using backstepping technique augmented by use of state and disturbance observer.

Nagendra Shivkumar Shete Design Economical Sensor & System to Incorporate the Fuel Enthalpy Loss for Efficiency Calculation

The effective boiler performance is centered on the efficiency of the boiler. The efficiency of boiler reduces with deteriorating quality of fuel. Liquid fuels like furnace oil and Low Sulphur Heavy Stock are

predominantly used in industrial application. There are many factor which add up the water in furnace oil. The water content in fuel leads to quality deterioration. It also causes spluttering of the same at the burner tip, possibly extinguishing the same and reducing the same temperature or lengthening the same. The increased water percentage in oil reduces the calorific value of fuel. This leads to capacity reduction of boiler. These problems can be avoided in time by on-line monitoring of water content. However approach to the design sensor and system to incorporate calorific value of fuel. The currently laboratory analysis methods are used for measurement of water in furnace oil. These methods are time consuming and costly. Objective of project is to design the cost effective method of on-line water percentage measurement in furnace oil. All techniques for water in furnace oil measurement are studied and compared. Capacitance sensor is designed and developed. Experimentation work carried out for characterization of sensor to suit application.

Akshat Singhal Fault Detection of Induction Motor Using Motor Current Signature Analysis

Condition monitoring of induction motor have been a challenging task for the engineers and researchers mainly in industries. There are many condition monitoring methods, including vibration monitoring, thermal monitoring, chemical monitoring, acoustic emission monitoring but all these monitoring methods require expensive sensors or specialized tools whereas current monitoring out of all does not require additional sensors. Current monitoring techniques are usually applied to detect the various types of induction motor faults such as rotor fault, short winding fault, air gap eccentricity fault, bearing fault, load fault etc. In current monitoring, no additional sensors are necessary. This is because the basic electrical quantities associated with electromechanical plants such as current and voltage are readily measured by tapping into the existing voltage and current transformers that are always installed as part of the protection system. As a result, current monitoring is non-intrusive and may even be implemented in the motor control center remotely from the motors being monitored. Motor current signature analysis (MCSA) approach fall under current monitoring. The MCSA uses the current spectrum of the machine for locating characteristic fault frequencies. When a fault is present, the frequency spectrum of the line current becomes different from healthy motor. Such fault modulates the air-gap and produces rotating frequency harmonics in the self and mutual inductances of the machine. It depends upon locating specific harmonic component in the line current.