Story Board for Simulation of Control Sytems Lab

Department of Electrical and Electronics Engineering

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Course Objectives

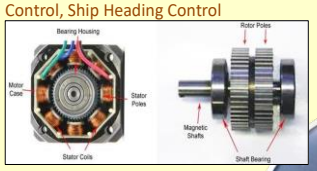
- To understand the different ways of system representations in Transfer function and state space representations
- To get transfer functions for various physical and laboratory based systems
- To design various controllers and compensators to improve system performance
- To get the performance of various devices .

Course Outcomes

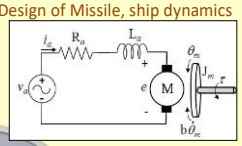
Students will be able to:

- Solve electrical engineering problems using MATLAB programming and SIMULINK models.
- Design various controllers and compensators to improve system performance and test them in the laboratory.
- To choose various devices for different applications in electrical systems.

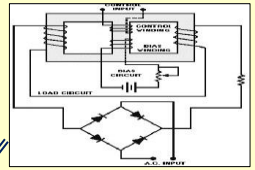
Stepper Motor Characteristics
Gun Positioning system, Radar Antenna Control, Ship Heading Control



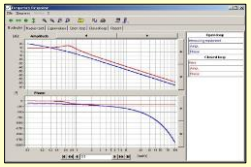
Transfer Function of DC Motor
Design of Missile, ship dynamics



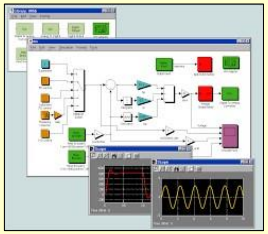
Characteristics of Magnetic Amplifier
SCADA, missile firing



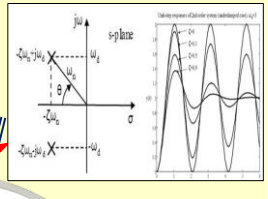
Stability Analysis of linear time invariant system using MATLAB



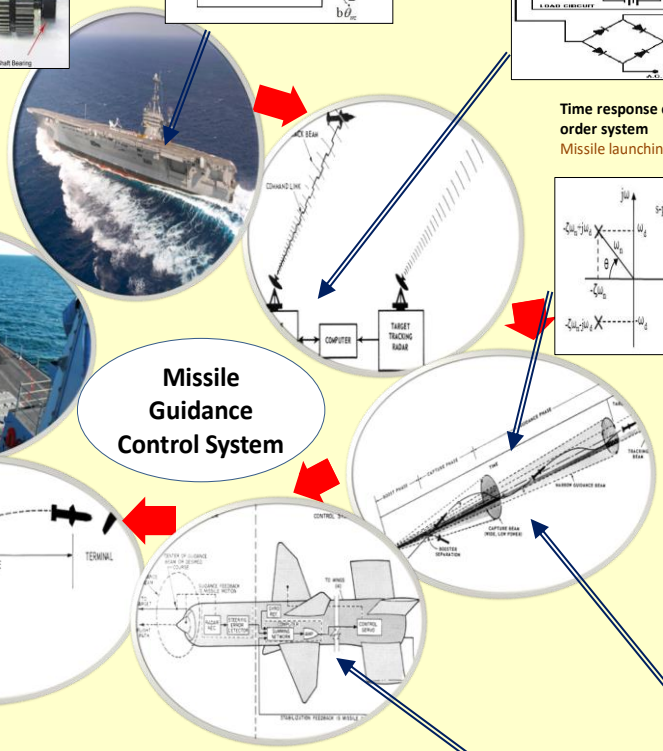
MATLAB simulation of P,PI, PID Controller



Time response characteristics of 2nd order system
Missile launching tracking.

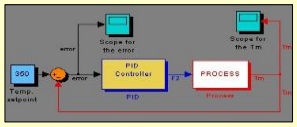


S.No	Name of the Experiment and Equipment
1	Time response characteristics of 2 nd order system
2	Characteristics of Synchros
3	Effect of feed back on DC servo motor
4	Transfer function of DC motor
5	Effect of P, PI, PD, PID controller on a second order systems
6	Lag Lead compensation – Magnitude and phase angle plot
7	Temperature controller using PID controller
8	Characteristics of Magnetic Amplifier
9	Stepper Motor Characteristics
10	Power Factor Improvement using SCADA
11	MATLAB simulation of P, PI, PID controller
12	Stability analysis (Bode, Root locus plot, Nyquist) of linear time invariant system using MATLAB
13	State space model for classic transfer function using MATLAB verification

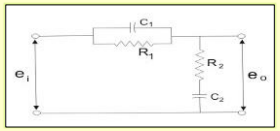


Missile Guidance Control System

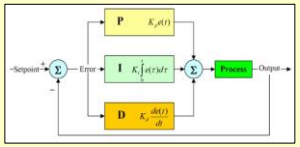
Temperature Controller using PID
Missile thrust launching, explosion



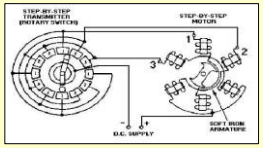
Lead-Lag compensator
Improving the performance



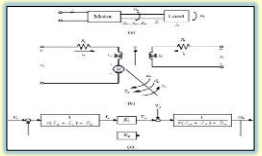
Effect of P,PI, PID Controller on a second order system
Design of Controllers



Characteristics of Synchros
Antenna Control



Effect of feedback on DC servo motor
Operation of Guidance System



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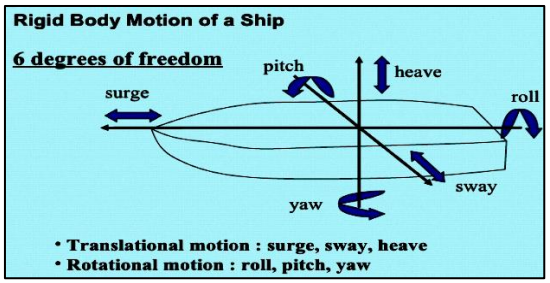
VNR VJIET CONTROL SYSTEM LAB (III -1)
Story Board: Guidance & Control of Ship Launched Missile

Control Engineering is of significant interest in development of innovative products of all range and types, it is playing increasing important role in the developing world. It is very crucial for the students to get the exposure to the contemporary control system equipment in a realistic manner. Control Systems and Simulation Laboratory connects the theoretical aspects taught in lectures with the realities of physical hardware. To understand the function of control system looping operations and design, we are having experiments both in realtime and in simulation environment in MATlab.

Let us consider the example of control system of a ship launched Missile; fired against an arial target. The missile is launched from the ship, because of wave motion, the platform is not stable. Missile launcher stabilizes against the disturbances acting on the platform

The target is tracked by Radar. Radar gives target in space. Missile guidance System will evolve missile has to follow the trajectory after haunch . the missile is controlled such that it follows the in X, Y, Z coordinates by appropriate rates about axis is called Pitch. Movement about y axis is called X, Y, Z coordinates and 3 moments about X, Y, Z freedom.



the instantaneous coordinates of a trajectory to hit the target. The control system will ensure that the trajectory by correcting the errors these axes. The moment about X roll. The three linear motion along axes are called six degrees of

The function of the control system is to correct the errors in X, Y, Z planes by giving appropriate commands to the control Surfaces usually called as Fins/Canards. The commands are calculated by onboard computer.

1) Sensing and Prediction of the of Target Position

The presence of Electromagnetic waves and infrared radiations indicates a moving target. To eliminate the possibility of homing on objects other than the target, a band-pass filter is inserted in the control circuit to eliminate interfering signals. A band-pass filter will pass only a narrow band of frequencies. In the context we study about first order and second order systems, given the specifications design can be done.

2) Launching of Missile

From the ground radar, the range and angle from the radar to the target are measured. From these raw measurements the position and velocity (and in some applications acceleration) of the target can be estimated.

Based on the filter estimates, a prediction of where the target will be in the future must be made a fire control solution could be achieved so that a missile could simply be launched at the correct angle and right time to also arrive at the predicted intercept point. It uses software for solving prediction and estimation. We have excercises in MATlab using looping operations, for, while, if etc.
For stabilizing the position of the radar, we use high precision stepper motor, and the corresponding control is illustrated in the Stepper Motor control using microcontroller program. We study the characteristics of the motors using Transfer Function approach. The corresponding Simulation is carried in MATLab. We do the comparative Analysis using different inputs, ramp, step, Impulse etc.

3) **Stabilization of the Platform**

When the missile is released from the ship, the stability of the platform is very important. The ship has six degrees of freedom, three translational, three rotational, surge, heave, sway, roll, yaw and pitch. Each of these variables have to be controlled. Controllers and Compensators are all pervasive in the applications to achieve the desired control in the variables. Long-range endoatmospheric missiles use thrust to build up speed only for a fraction of the flight. After that fuel is expended the missile must glide to the target.

4) Tracking system

A servomechanism is an electromechanical device that positions an object in accordance with a variable signal. We explain the closed loop operation of the system. We have Closedloop speed control of DC motor, which illustrates the complete operations.
Tachometer generators are used to measure the angular velocity of the missile. The output of the generator is a voltage proportional to the angular velocity (rate) of the Missile. This voltage is sent to a servo amplifier to aid in stabilizing the Motion of the missile. The experiments on Synchros and Magnetic Amplifier illustrates the corresponding aspects. The gyro measures the missile's angular velocity about a particular axis (yaw, pitch, or roll). The output of the gyro is a voltage that is proportional to missile angular velocity (rate) about an axis.

6) Explosion of Missile after hitting Target

The temperature controlled sensors or equipment will respond immediately only after the missile is hitting the target, they will keep the controlled temperature during all the previous phases to ensure it is not exploded untimely. We have temperature controllers design on oven to bring to the system to any desired temperature.
Basic operation of the guidance and control system is based on the closed-loop or servo principle. The control units make corrective adjustments of the missile control surfaces when a guidance error is present, in other words, when the missile is not on the correct course to the target.