Date of Notification 5/20/22
Date of Award : 06/09/

Name :- **MD ISTIYAQUE**
Title of Thesis :- **Optimal Controller Design for Autonomous System**
Roll No :- **15 PHDEE 10**
Enrollment No :- **06-3529**
File No :- **ENGG/534/2022**
Date of Viva-voce :- 24-08-2022

The process of optimal controller design initiates with formulation of mathematical model of the system, the further step is identifying the physical restriction imposed on the system. In the first phase of study the Euler-Lagrange method is used to derive a mathematical model of the inverted pendulum system. It is revealed that the system is nonlinear; therefore, it is linearized close to the vertical position. With the help of state space and the transfer function the modelling has been done. The proposed DIP model is simulated using MATLAB.

In the next step, a linear quadratic regulator approach is used for controller design. The performance of the developed controller is optimized by choosing a suitable performance index. The proposed linear quadratic regulator is tested for two different disturbance input sets. Model predictive control is an optimization-based method for the feedback control of any linear or nonlinear systems. The MPC controller wants to determine the best anticipated path that is closest to the reference, it runs several future procpective. However, rather of doing these simulations in a random sequence, it does it in a systematic manner, where optimizer comes in, by solving an online optimization issues. The Laguerre function is an arbitrary function which is formulated during evolution of dynamical model of the plat, with a combination of ortho-normal basis functions and has Laplace Transformations also. It can be considered as an approximation to to the system model's discrete time impulse response. Designing of model predictive controller is base on Laguerre function.

The optimization techniques like Genetic Algorithm (GA), Bacterial Foraging (BF), Particle Swarm Optimization(PSO) and many more are remark-ably used by the researchers, scientist and even by the engineers to optimize their problems efficiently. The popularity of these techniques is that they can be applied directly through the computer, regardless the complexity of the problem.

Tuning the gains of the PID controller is always a challenge for the researcher. The meta-heuristic algorithm provides the best solution to such problems and avoids the complexity involved in manual tuning of these gain in real time environment. In this work, three optimization algorithms namely GA, PSO and GWO are used to fine tune those gains within a defined range. The purpose of the each algorithm is to provide the exact values of gain with minimization of the selected performance criteria i.e. ITAE and ISE.