Linear Optimal Control Systems

Optimal projection equations The linear-quadratic-Gaussian (LQG) control problem is one of the most fundamental optimal control problems. It concerns uncertain linear systems disturbed In control theory, optimal projection equations constitute necessary and sufficient conditions for a locally optimal reduced-order LQG controller 6891666e47

Control system The control systems are designed via control engineering process. It can range from a single home heating controller using a thermostat controlling a domestic boiler to large industrial control systems which are used for controlling processes or machines. A control system manages, commands, directs, or regulates the behavior of other devices or systems using control loops. It can range from a single home A control system manages, commands, directs, or regulates the behavior of other devices or systems using control loops 6891666e47

Model predictive control It has been in use in the process industries in chemical plants and oil refineries since the 1980s. As in linear MPC, NMPC requires the iterative solution of optimal control problems on a finite prediction horizon. The main advantage of MPC is the fact that it allows the current timeslot to be optimized, while keeping future timeslots in account. In recent years it has also been used in power system balancing models and in power electronics. Model predictive control (MPC) is an advanced method of process control that is used to control a process while satisfying a set of constraints. This is achieved by optimizing a finite time-horizon, but only implementing the current timeslot and then optimizing again, repeatedly, thus differing from a linear–quadratic regulator (LQR. Model predictive controllers rely on dynamic models of the process, most often linear empirical models obtained by system identification. nonlinear system models in the prediction 6891666e47

For continuously modulated control, a feedback controller is used to automatically control a process or operation. The control system compares the value or status of the process variable (PV) being controlled with the desired value or setpoint (SP), and applies the difference as a control signal to bring the process variable output of the plant to the same value as the setpoint. 6891666e47

Optimal control It has numerous applications in science, engineering and operations research. For example, the dynamical system might be a spacecraft with controls corresponding to rocket thrusters, and the objective might be to reach the Moon with minimum fuel expenditure. A dynamical system may also be introduced to embed operations research problems within the framework of optimal control theory. Optimal control theory is a branch of control theory that deals with finding a control for a dynamical system over a period of time such that an objective Optimal control theory is a branch of control theory that deals with finding a control for a dynamical system over a period of time such that an objective function is optimized. Or the dynamical system could be a nation's economy, with the objective to minimize unemployment; the controls in this case could be fiscal and monetary policy 6891666e47

Optimal control is an extension of the calculus of variations, and is a mathematical... 6891666e47 The linear-quadratic-Gaussian (LQG) control problem is one of the most fundamental optimal control problems. It concerns uncertain linear systems disturbed by additive white Gaussian noise, incomplete state information (i.e. not all the state variables are measured and available for feedback) also disturbed by additive white Gaussian noise and quadratic costs. Moreover, the solution is unique and constitutes a linear dynamic feedback control law that is easily computed and implemented. Finally the LQG controller is also fundamental to the optimal perturbation control of non-linear systems. 6891666e47

Control theory The objective is to develop Control theory is a field of control engineering and applied mathematics that deals with the control of dynamical systems. Control theory is a field of control engineering and applied mathematics that deals with the control of dynamical systems. The objective is to develop a model or algorithm governing the application of system inputs to drive the system to a desired state, while minimizing any delay, overshoot, or steady-state error and ensuring a level of control stability; often with the aim to achieve a degree of optimality 6891666e47

Under these assumptions an optimal control scheme within the class of linear control laws can be derived by a completion-of-squares argument. This control law which is known as the LQG controller, is unique and it is simply a combination of a Kalman... 6891666e47 LQR controllers possess inherent robustness with guaranteed gain and phase margin, and they also are part of the solution to the LQG (linear–quadratic–Gaussian) problem. Like the LQR problem itself, the LQG problem is one of the most fundamental problems in control theory. 6891666e47 To do this, a controller with the requisite corrective behavior is required. This controller monitors the controlled process variable (PV), and compares it with the reference or set point (SP). The difference between actual and desired value of the process variable, called the error signal, or SP-PV error, is applied as feedback to generate a control action to bring the controlled process... 6891666e47

Linear–quadratic–Gaussian control Output measurements are assumed to be corrupted by Gaussian noise and the initial state, likewise, is assumed to be a Gaussian random vector. predictive control. It concerns linear systems driven by additive white Gaussian noise. The problem is to determine an output feedback law that is optimal in the sense of minimizing the expected value of a quadratic cost criterion. The problem is to determine an output feedback law that is optimal in In control theory, the linear–quadratic–Gaussian (LQG) control problem is one of the most fundamental optimal control problems, and it can also be operated repeatedly for model predictive control. It concerns linear systems driven by additive white Gaussian noise 6891666e47

Optimal experimental design same precision as an optimal design. The creation of this field of statistics has been credited to Danish statistician Kirstine Smith. In practical terms, optimal experiments can reduce the costs of experimentation. The optimality of a design depends In the design of experiments, optimal experimental designs (or

optimum designs) are a class of experimental designs that are optimal with respect to some statistical criterion 6891666e47

The optimality of a design depends on the statistical model and is assessed with respect to a statistical criterion, which is related to the variance-matrix... 6891666e47

Stochastic control Stochastic control aims to design the time path of the controlled variables that performs the desired control task with minimum cost, somehow defined, despite the presence of this noise. Stochastic control or stochastic optimal control is a sub field of control theory that deals with the existence of uncertainty either in observations Stochastic control or stochastic optimal control is a sub field of control theory that deals with the existence of uncertainty either in observations or in the noise that drives the evolution of the system. The system designer assumes, in a Bayesian probability-driven fashion, that random noise with known probability distribution affects the evolution and observation of the state variables. The context may be either discrete time or continuous time 6891666e47

In the design of experiments for estimating statistical models, optimal designs allow parameters to be estimated without bias and with minimum variance. A non-optimal design requires a greater number of experimental runs to estimate the parameters with the same precision as an optimal design. In practical terms, optimal experiments can reduce the costs of experimentation. 6891666e47 For sequential and combinational logic, software... 6891666e47

Bang–bang control Most common residential thermostats are bang–bang controllers. If the optimal control switches In control theory, a bang–bang controller (hysteresis, 2 step or on–off controller), is a feedback controller that switches abruptly between two states. Due to the discontinuous control signal, systems that include bang–bang controllers are variable structure systems, and bang–bang controllers are thus variable structure controllers. In optimal control problems, it is sometimes the case that a control is restricted to be between a lower and an upper bound. The Heaviside step function in its discrete form is an example of a bang–bang control signal. They are often used to control a plant that accepts a binary input, for example a furnace that is either completely on or completely off. These controllers may be realized in terms of any element that provides hysteresis 6891666e47

Linear–quadratic regulator The case where the system dynamics are described by a set of linear differential equations and the cost is described by a quadratic function is called the LQ problem. The case where the system dynamics are described by a set of linear differential The theory of optimal control is concerned with operating a dynamic system at minimum cost. of optimal control is concerned with operating a dynamic system at minimum cost. One of the main results in the theory is that the solution is provided by the linear–quadratic regulator (LQR), a feedback controller whose equations are given below 6891666e47

The LQG controller itself is a dynamic system like the system... 6891666e47