

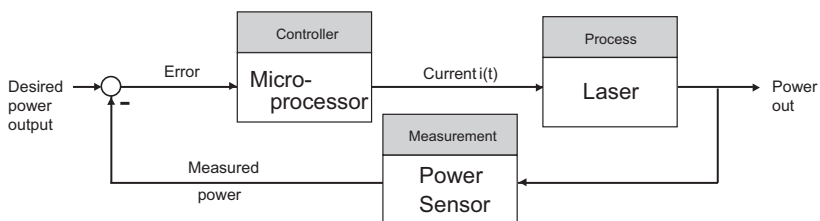
CHAPTER 1

Introduction to Control Systems

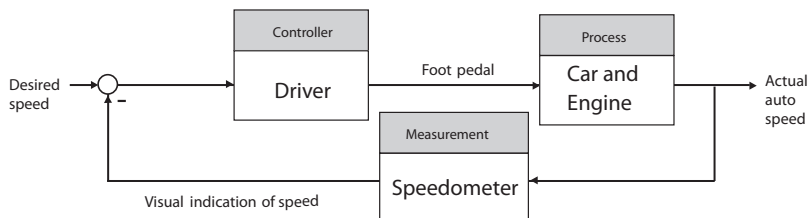
There are, in general, no unique solutions to the following exercises and problems. Other equally valid block diagrams may be submitted by the student.

Exercises

E1.1 A microprocessor controlled laser system:

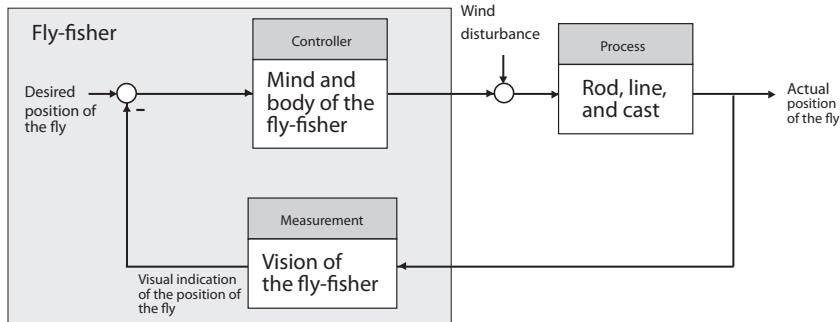


E1.2 A driver controlled cruise control system:

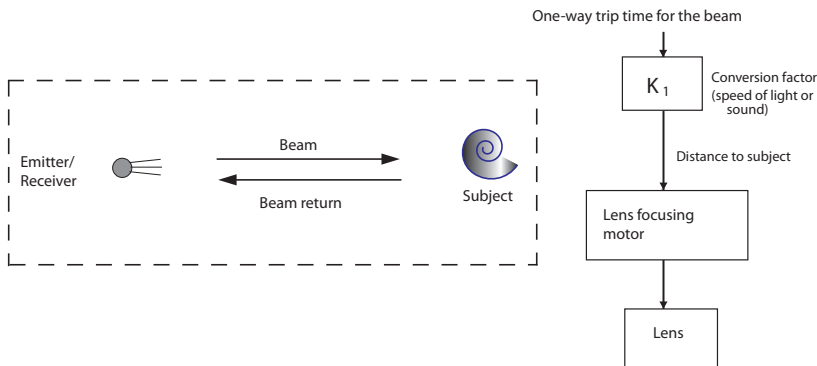


E1.3 Although the principle of conservation of momentum explains much of the process of fly-casting, there does not exist a comprehensive scientific explanation of how a fly-fisher uses the small backward and forward motion of the fly rod to cast an almost weightless fly lure long distances (the

current world-record is 236 ft). The fly lure is attached to a short invisible leader about 15-ft long, which is in turn attached to a longer and thicker Dacron line. The objective is cast the fly lure to a distant spot with dead-eye accuracy so that the thicker part of the line touches the water first and then the fly gently settles on the water just as an insect might.

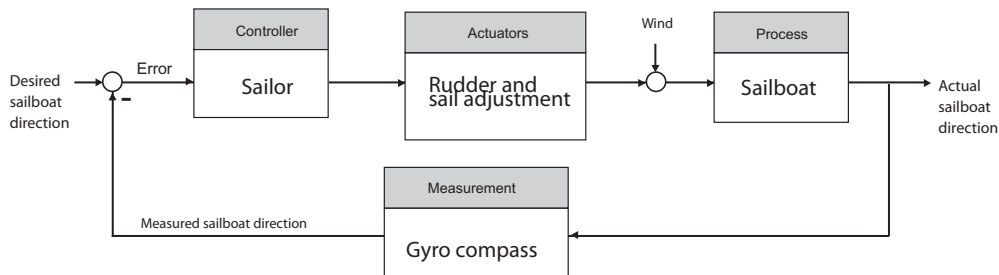


E1.4 An autofocus camera control system:

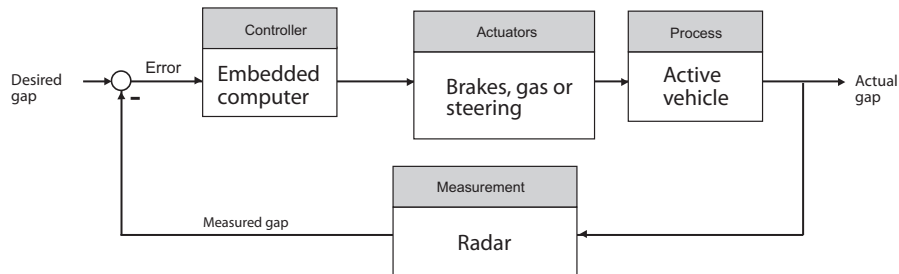


Exercises

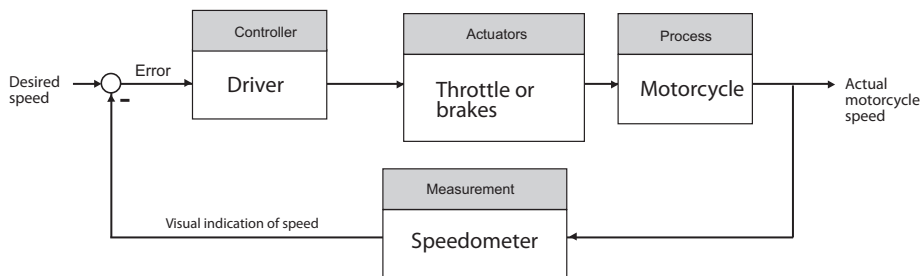
E1.5 Tacking a sailboat as the wind shifts:



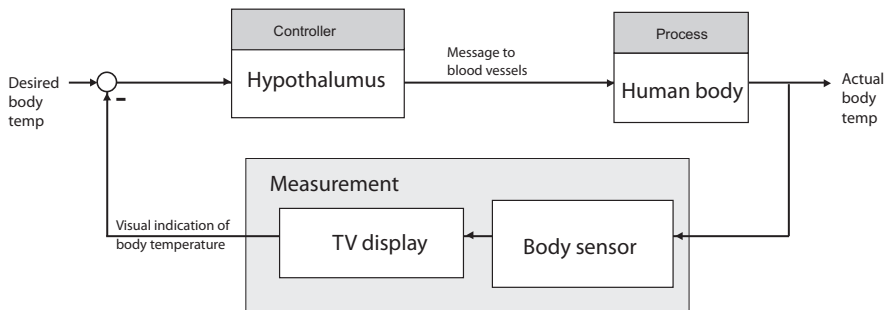
E1.6 An automated highway control system merging two lanes of traffic:



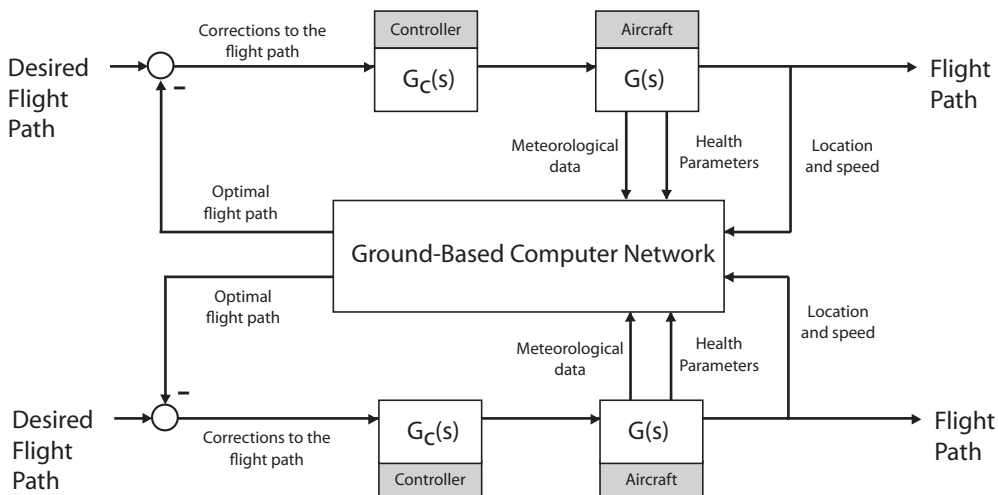
E1.7 Using the speedometer, the driver calculates the difference between the measured speed and the desired speed. The driver throtle knob or the brakes as necessary to adjust the speed. If the current speed is not too much over the desired speed, the driver may let friction and gravity slow the motorcycle down.



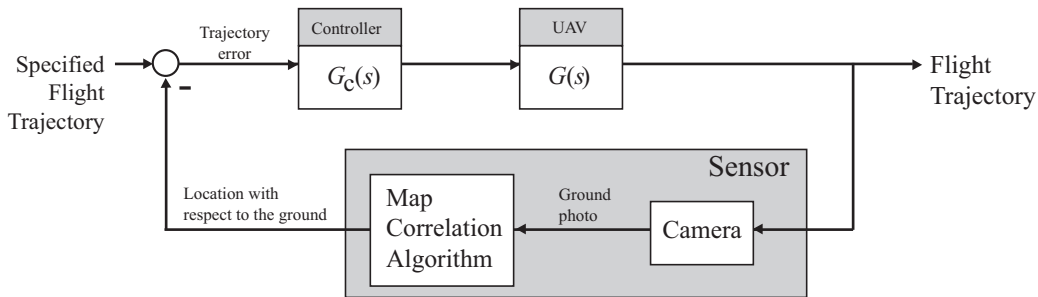
E1.8 Human biofeedback control system:



E1.9 E-enabled aircraft with ground-based flight path control:

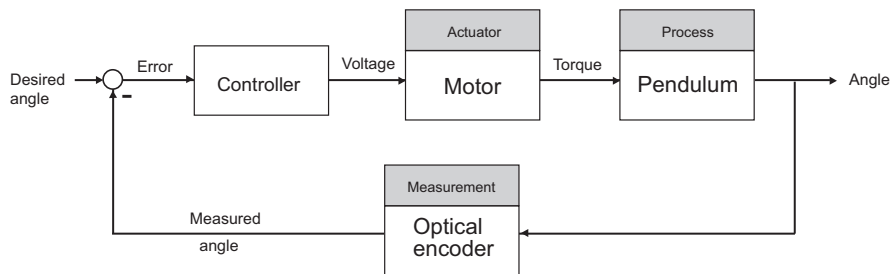


E1.10 Unmanned aerial vehicle used for crop monitoring in an autonomous mode:

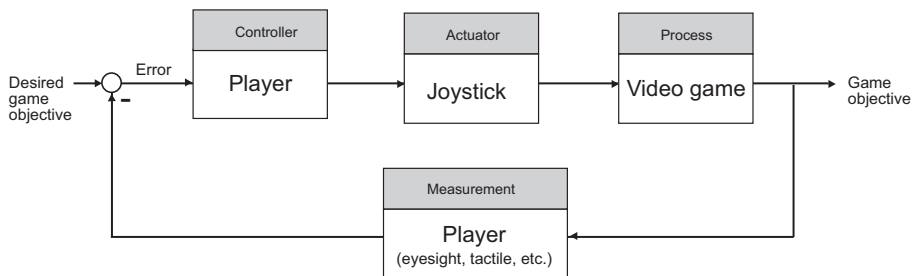


Exercises

E1.11 An inverted pendulum control system using an optical encoder to measure the angle of the pendulum and a motor producing a control torque:

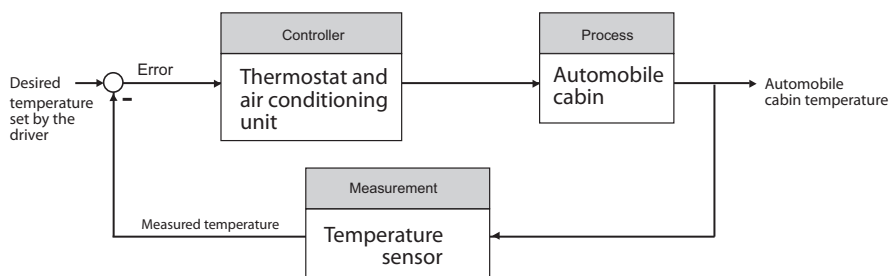


E1.12 In the video game, the player can serve as both the controller and the sensor. The objective of the game might be to drive a car along a prescribed path. The player controls the car trajectory using the joystick using the visual queues from the game displayed on the computer monitor.

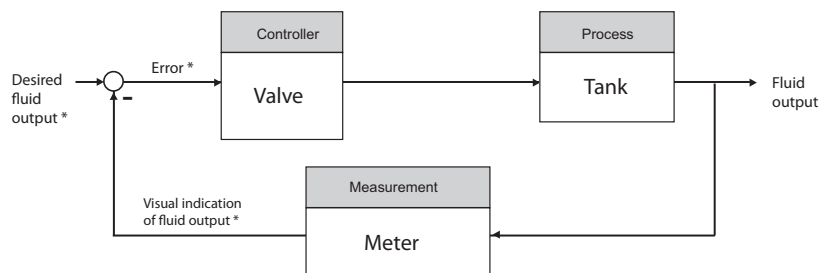


Problems

P1.1 An automobile interior cabin temperature control system block diagram:

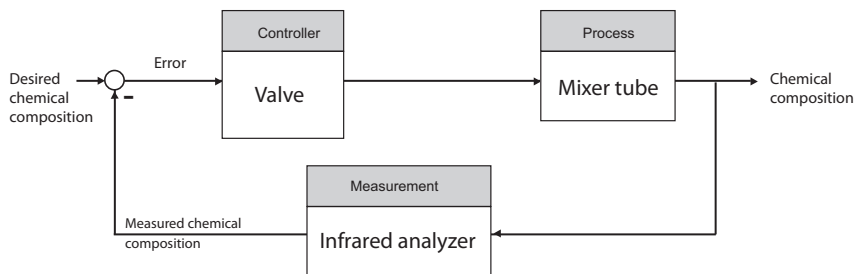


P1.2 A human operator controlled valve system:



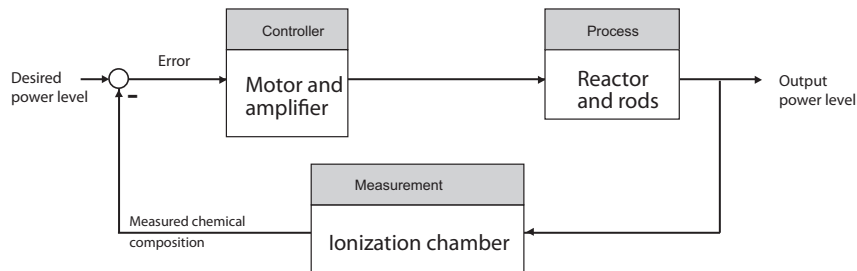
* = operator functions

P1.3 A chemical composition control block diagram:

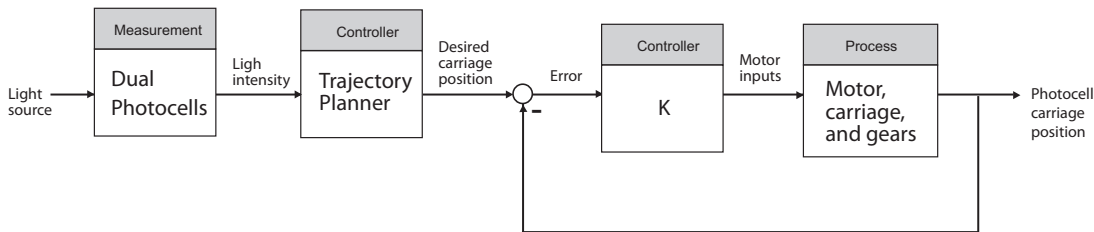


Problems

P1.4 A nuclear reactor control block diagram:



P1.5 A light seeking control system to track the sun:



P1.6 If you assume that increasing worker’s wages results in increased prices, then by delaying or falsifying cost-of-living data you could reduce or eliminate the pressure to increase worker’s wages, thus stabilizing prices. This would work only if there were no other factors forcing the cost-of-living up. Government price and wage economic guidelines would take the place of additional “controllers” in the block diagram, as shown in the block diagram.

