Objective

Model identification of a runner’s heart and implementing a discrete time PID controller to the obtained model. Real plant application of the implemented PID. The opportunity to use and implement MATLAB System Identfication Toolbox and PID Tuner.

Information

* System identification definition, uses, importance
* Human heart, natural regularization
* Polar FT-7 heart rate monitor watch/chestband and treadmill

Preliminary Work

* Draw the block diagram of the overall system
* Obtaining a FOPDT model without computational tools
* PID design without computational tools

Experimental Procedure

* Running and data collecting, data preparing for model identification
* System identification of a runner’s heart via MATLAB with various running conditions, choosing right model structure according to the response. (i.e. if overshoot exists, don’t choose FOPDT)
* Discrete PID design with MATLAB & Simulink
* Simulation of the PID controlled model
* Replacement of plant with the runner and attempt to control the heart rate of the runner (Human in the Loop)

Results and Discussion

* Why did we say that the running action should be done by the same person throughout the experiment? What can be expected to happen if the runner becomes someone else while data collecting?
* Discuss briefly, how the MATLAB System Identification Tool approaches to the plant to find an approximate model? Compare this with the manual model fitting in the preliminary work.
* Why did the model parameter’s change under different running conditions?
* Did the “0-5km/h+0 degree” response include an overshoot? If yes, discuss the reasons why.
* Explain why we chose the discrete PID controller in this experiment? What are the advantages and disadvantages of using a discrete PID in this experiment?
* Discuss briefly, how the PID tuning of MATLAB works. Without MATLAB, purpose a method to fine tune the PID parameters around a given starting point.
* Comment on the “Human in the Loop” method. What are the discrepancies with respect to the obtained runner heart model?

Conclusions