Modelling and control summaries

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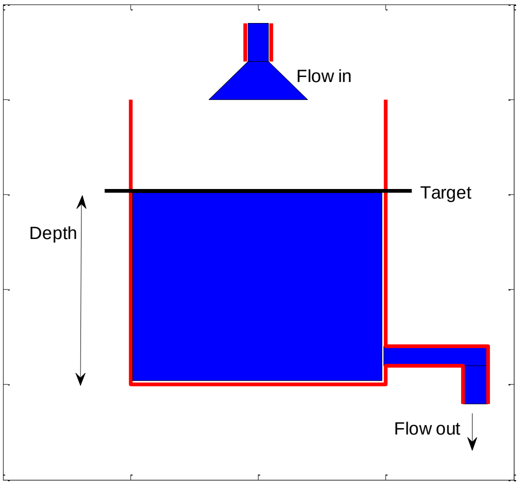
MATLAB GUIs – tank level responses

ASSUMPTION: Students should understand the context of level control for tank systems and if necessary view the modelling section linked to that.



For h the depth, A the cross-sectional area, ρ density, g acceleration due to gravity, R a constant linked to the outflow pipe and f_{in} the flow in, then a simplified linear model is:

$$A\frac{dh}{dt}+[R\rho g]h = f_{in}$$

The GUI assumes the following model (A=50 and Rρg=1).

$$\frac{dh}{dt}+0.02h=0.02f_{in}$$

The GUI allows three different control laws for selecting the input flow f_{in}:

1. Open-loop with f_{in}=0.
2. Open-loop with f_{in}=1
3. Closed loop with fin chosen by a PI compensator (r the desired depth).

$$f_{in}=K_p(r-h)+K_i\int_0^t(r-h)dt$$

REMARK: Combining the model dynamics with the PI compensator results in a 2nd order closed-loop system. Students may wish to analyse the expected responses before using the GUI to test their answers using A=50 and Rρg=1.

$$50\frac{d^2h}{dt^2}+[1+K_p]\frac{dh}{dt}+K_ih=K_p\frac{dr}{dt}+K_ir$$

NOTE: A choice of K_i=0 implies that the closed-loop dynamics reduce to a 1st order model:

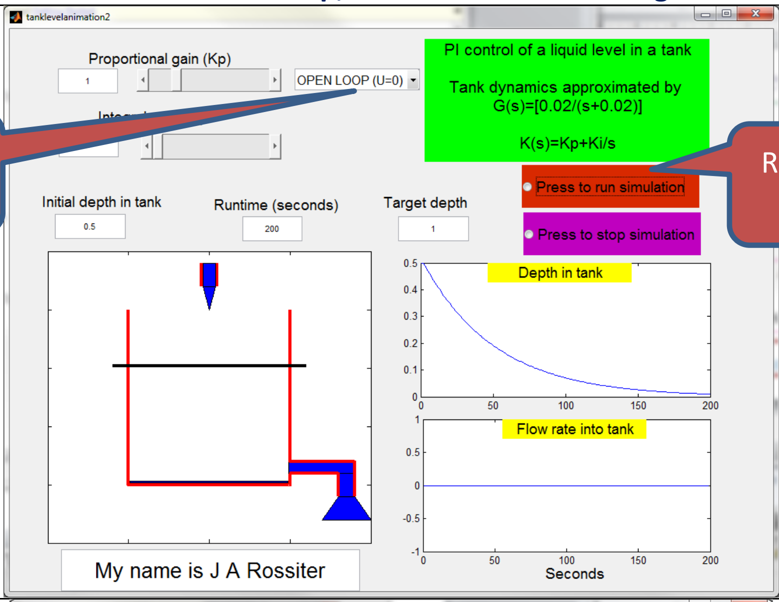
$$50\frac{dh}{dt}+(1+K_p)h=K_pr$$

ILLUSTRATIONS – the simulation runs fast compared to real time and students will see the tank filling and emptying over about 10sec.

FILENAMES are tanklevelanimation2.p, tanklevelanimation2.fig

Option 1: f_{in}=0

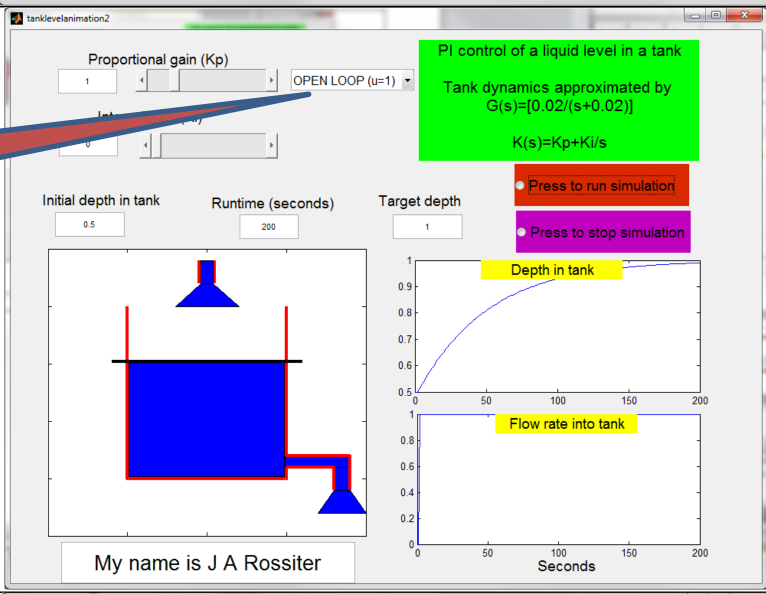
Choice of zero input and open-loop



Run button here.

Option 2: f_{in}=1

Choice of input = 1 and open-loop



Option 3: PI feedback

Change PI parameters here.

Change h(0), runtime and target r if desired.