DCM III: Homework

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1 Homework set

For this homework we will get to understand parts of the Balloon model as well as keep up our skills in understanding dynamic equations.

1.1 Set I

For the first set, we will get to solve the Flow equations which are given by the following:

$$\frac{ds}{dt} = z(t) - \kappa s - \gamma(f-1), \tag{1}$$

$$\frac{df}{dt} = s, \tag{2}$$

with the conditions at $t = 0$, $f = 1$, $s = 0$, and setting the input $z(t)$ as:

$$z(t) = 0.5 \exp\left[-(t-2)^2/0.1\right]. \tag{3}$$

Initially use the following numbers for the parameters: $\kappa = 0.65$ and $\gamma = 0.41$. Remember to use what we have learned spefiically that:

$$\frac{ds}{dt} \approx \frac{\Delta s}{\Delta t} = \frac{s_{t_{i+1}} - s_{t_i}}{\Delta t}. \tag{4}$$

And use this approximation for f as well. For the numerical simulation set $\Delta t = 0.001$, and set the maximum length of t to be 50 You should have the following solution in Figure 1.Make sure you get the figures right before moving on!.

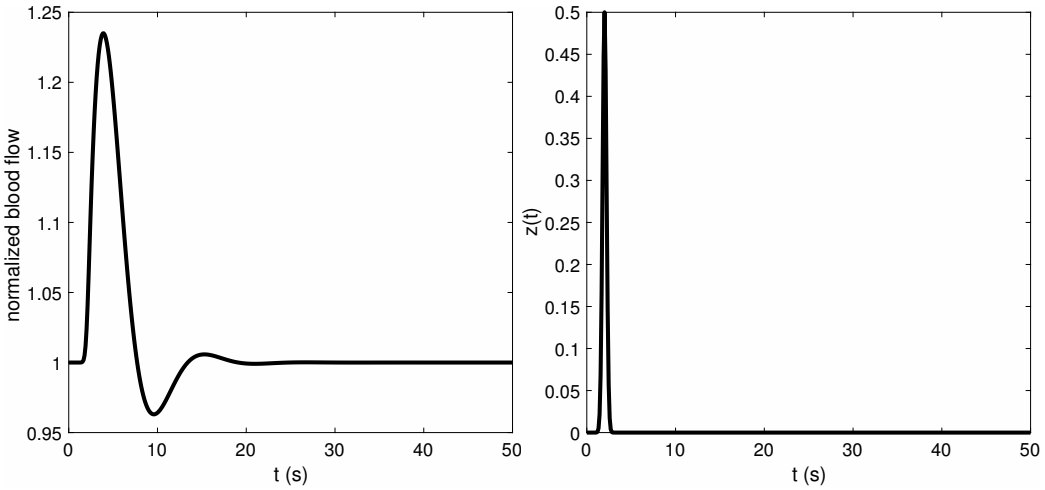

Figure 1: What the solution should look like

1.2 Set II

After you have completed Set I, then simulate the same system using:

$$z(t) = 0.5 \exp\left[-(t-2)^2/0.1\right] + 0.5 \exp\left[-(t-\tau)^2/0.1\right]. \tag{5}$$

where τ is 3. After this plot the flow response for $\tau = 4, 5, 6, 7$. Have a look at the responses and save/print out for next session!.

1.3 Set III

Finally repeat what we did in Set I, changing $\kappa = 0.3, 0.7$ and then keep κ constant and set $\gamma = 0.2, 0.8$.

Have all these plots ready in some electronic or printed format! :)