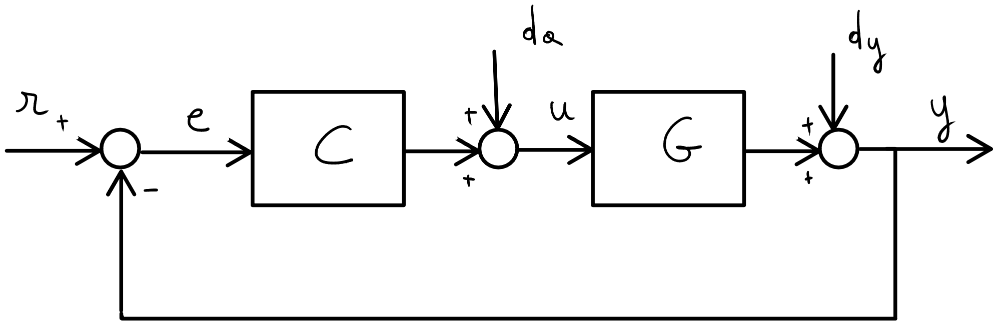
Getting started with Simulink: simulation of a feedback control system

Sophie Fosson



$$G(s) = \frac{2122.4}{s(s+59.24)} \qquad C(s) = 4.54\,\frac{1+\frac{s}{59.2}}{1+\frac{s}{218.8}} \qquad r(t)=\varepsilon(t),\ d_a(t)=d_y(t)=0$$

Simulate the responses of $y(t),\ u(t),\ e(t)$

For $y(t)$, evaluate
1. the steady state value y_∞
2. the maximum overshoot $\hat{s}$
3. the rise time t_r
4. the settling time $t_{s,1\%}$

For $u(t)$, evaluate $\max_t |u(t)|$

For $e(t)$, evaluate the steady state value $|e_\infty|$

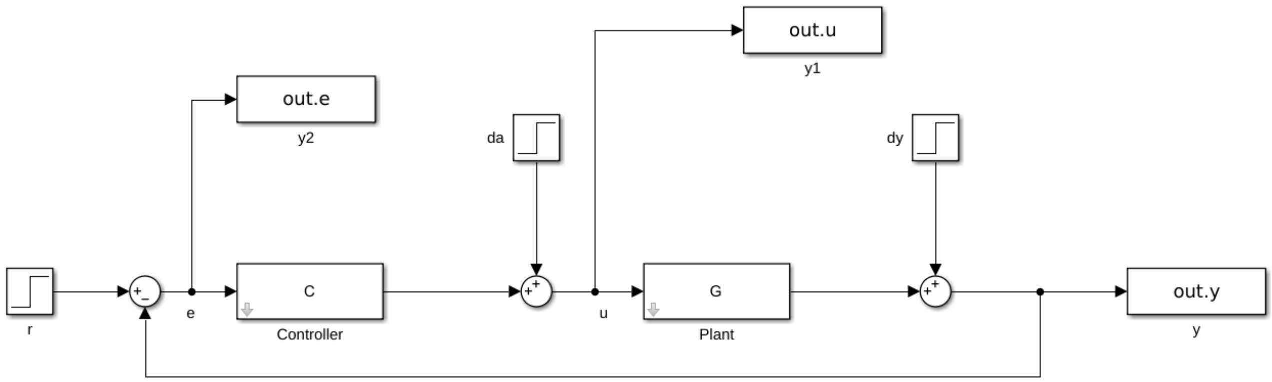
Notes:

Simulink is a block diagram environment. We use it to perform numerical simulations of dynamical systems

In the first weeks: we have analytically solved LTI systems, that is, we have computed the analytical expression of the output response.
With Simulink: we compute a numerical solution, that is, the output response is expressed as a time series: a vector of discretized data, associated with a vector of discretized time instants.

Simulink model --> file .slx.
We use an .m file to launch this model and to provide parameters' value.
Important: the .slx file and the .m file must have different names

Simulink blocks used in the first example:
1) [Control system toolbox] LTI system
2) sum
3) [sources] step (remember to set "step time" to 0)
4) [sinks] simout

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my_output = sim('feedback_simulation.slx')

plot(my_output)
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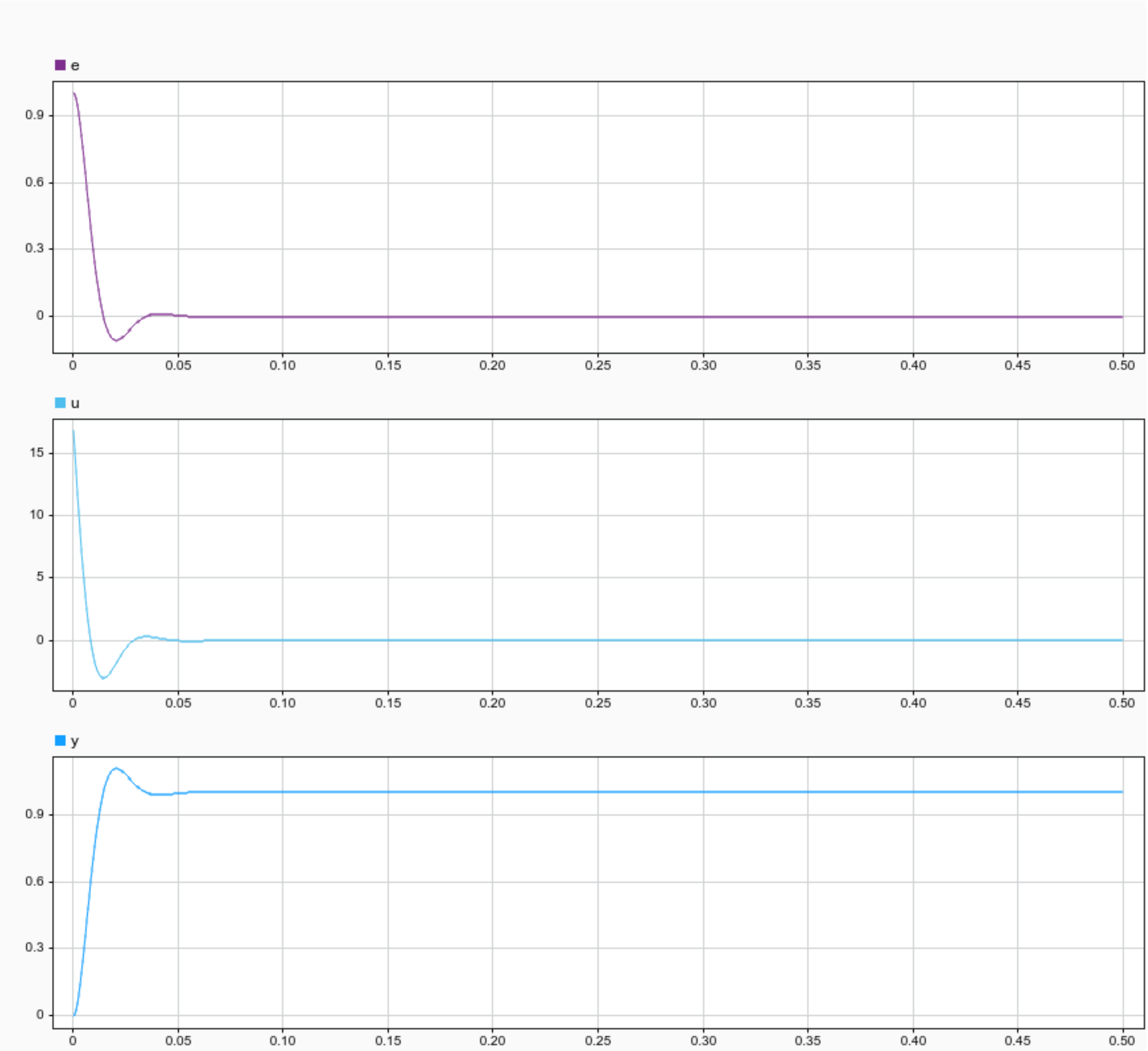

Solutions read on the Simulink graphs:

$$\underbrace{y_\infty = 1, \quad \hat{S} \approx 10.69, \quad t_r \approx 0.01, \quad t_{s,1\%} \approx 0.04,}_{\text{Compare them with } \texttt{>> stepinfo(T)}} \quad \underbrace{\max_t |u(t)| \approx 16.8,}_{\text{Compare it with } \texttt{>> max(abs(my\_output.u.Data))}} \quad |e_\infty| = 0$$