Modelling and control summaries

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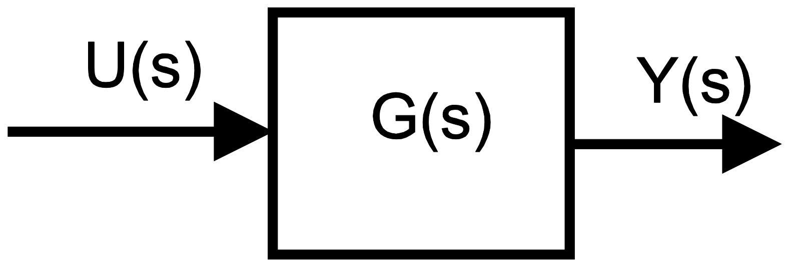
Behaviours 2 – systems or signal

Focus of this summary is to consider confusion that may arise when talking about signals and systems and thus form an acceptable language.
Often engineers will talk interchangeably about systems and signals – while this could be considered sloppy, in practice it is permissible due to the explicit link between the two.

WHAT IS A SIGNAL AND WHAT IS A SYSTEM?

- Signals are functions of time such as u(t) and y(t). These have Laplace transforms U(s) and Y(s).
- A system considers of real components. The response of the system (that is y(t)) depends upon the input to the system (that is u(t)). Linear systems may be represented by transfer functions such as G(s) here.



The response of the system is denoted as Y(s)=G(s)U(s).
The Laplace transform of the system output is the system transfer function times the Laplace transform of the system input.
NOTE the use of different words: (i) Laplace transform for signals and (ii) transfer function for systems. The transfer function will originate from an ODE or something similar.

KEY OBSERVATIONS:

1. The system behaviour is in effect contained in Y(s).
2. However Y(s) includes both G(s) and U(s) and thus has 2 behaviours: (i) behaviours associated to the input signal u(t) and (ii) behaviours associated to the system dynamics (from G(s) or ODE parameters).

It is normal to assume that the input is convergent, that is a step signal or similar. Consequently any instability must come from G(s).

CONCLUSION: One can talk interchangeably about the stability of the system or the convergence of Y(s) as they reduce to the same analysis even though one is a signal and one a system.

- Instability should refer to divergent system behaviour but critically can be assessed based on ensuring either Y(s) or G(s) have only LHP poles, if one assumes that U(s) is convergent.
- Any RHP pole implies divergence or instability.