Transient response performance

Stable system time responses are often described in terms of two intervals, loosely defined as transient—the first part during which the effects of initial conditions remain significant—and steady-state—the second part during which the response has "settled" near its final value or final amplitude of oscillation. In this chapter, we consider performance in terms of the transient response; in the next, we will consider it in terms of the steady-state response—specifically as steady-state error. Transient response characteristics are typically found via two methods:

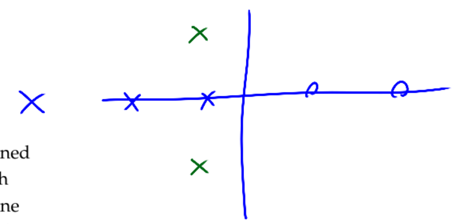
1. analytically and
   a) precisely for first- and second-order systems without zeros and
   b) approximately for first- and second-order systems with zeros and higher-order systems that have dominant poles relatively close to the imaginary complex-plane axis and
2. numerically, in simulation.

The analytical method is especially advantageous for design. Design methods we will learn in Chapter rldesign require we "place" the closed-loop poles in the complex plane. The transient response depends very much on this placement, and exactly how is something we can better understand from studying first- and second-order system response. We can only simulate systems defined by concrete numbers, so simulation, although powerful, is typically more helpful to fine-tune a controller rather than design it "from scratch."

$$H(s) = \frac{s+3}{(s+1)(s+2)}$$

Poles $s=-1$, $s=-2$

Zeros $s=-3$



$$H(s) = \frac{1}{(s+10)(s+1)(s+2)}$$

Approximate as

$$H(s) = \frac{1}{(s+1)(s+2)}$$