Closed-loop transfer function

From Wikipedia, the free encyclopedia

A **closed-loop transfer function** in control theory is a mathematical expression (algorithm) describing the net result of the effects of a closed (feedback) loop on the input signal to the circuits enclosed by the loop.

Contents

Overview

The closed-loop transfer function is measured at the output. The output signal waveform can be calculated from the closed-loop transfer function and the input signal waveform.

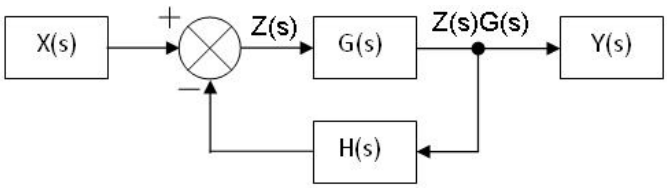
An example of a closed-loop transfer function is shown below:

The summing node and the *G*(*s*) and *H*(*s*) blocks can all be combined into one block, which would have the following transfer function:

$$\frac{Y(s)}{X(s)} = \frac{G(s)}{1 + G(s)H(s)}$$

Derivation

We define an intermediate signal Z shown as follows:



Using this figure we write:

$$Y(s) = Z(s)G(s)$$

$$Z(s) = X(s) - Y(s)H(s)$$

$$X(s) = Z(s) + Y(s)H(s)$$

$$X(s) = Z(s) + Z(s)G(s)H(s)$$

$$\Rightarrow \frac{Y(s)}{X(s)} = \frac{Z(s)G(s)}{Z(s) + Z(s)G(s)H(s)}$$

$$\frac{Y(s)}{X(s)} = \frac{G(s)}{1 + G(s)H(s)}$$

Centrifugal Governor at the Science Museum London. picture by Mirko Junge. See e.g. https://www.reddit.com/r/steamporn/comments/2c8kk5/centrifugal_governor_at_the_science_museum_london/

See also

- Federal Standard 1037C
- Open-loop controller

References

- This article incorporates public domain material from the General Services Administration document "Federal Standard 1037C" (http://www.its.bldrdoc.gov/fs-1037/fs-1037c.htm).