Feedback/Control Systems

I. Introduction

- Purpose of feedback systems
- How to build a feedback system
- How to fine tune a feedback system (damping)

II. Control system terminology

- Input - stimulus from external source/sensor.
- Output - response of the system.
- Feedback - output sample used to modify performance of the system.

II. Control system terminology

- Error - difference between input and feedback.
- Open-loop control - control action based on input independent of output.
- Closed-loop control - control action is dependent on output of system.
  - Advantage of closed-loop: system controls accuracy of the output for self regulation

III. Characteristics

- Position Feedback: employed to make the output exactly follow the input where a linear or angular displacement is desired.
- Rate feedback: used to smooth a motion or displacement and to restrict the velocity of the output.
- Acceleration feedback: further restriction to change in velocity of system which, together with velocity, prevent overshoot and oscillation (smooth motion).

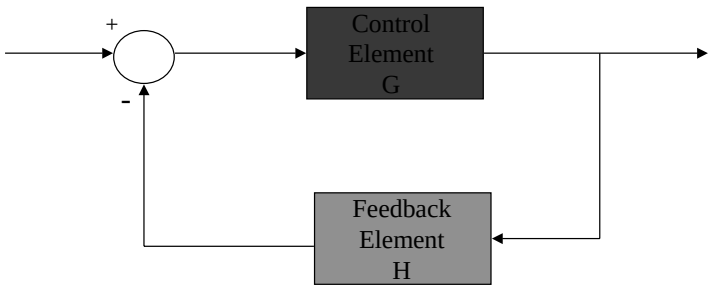
IV. Control system building blocks

- Control Element (G): math model of system components without f/b
- Summing point: (+) or (-) two or more signals
- Splitting point: sampling point => outputs = inputs
- Input (r = reference):

IV. Control system building blocks

- Control output(c):
- Error signal (e): difference between input and f/b
- Feedback element (H):
- Feedback signal (b):

V. Control system block diagram



VI. Response in feedback control systems

- No damping - rapid and continuous oscillation, neglecting friction.
- Underdamping: rapidly overshoots the desired output and oscillates about the desired value. The frequency of oscillation is reduced slowly. (quick response, long oscillations).

VI. Response in feedback control systems

- Overdamping: slowly achieves desired level with no overshoot (very slow response, no oscillations).
- Critical damping: exhibits the minimum response time possible without overshooting desired new position (fair response time, and no overshoot).

VI. Response in feedback control systems

- Realistic systems: usually slightly underdamped to get rapid response, minimum overshoot.