Modeling and control

Problems:

1. Transcient response, system type and steady state errors.(P-control)

   A simple model of a DC-motor is a first order system from voltage, $Va(s)$, to

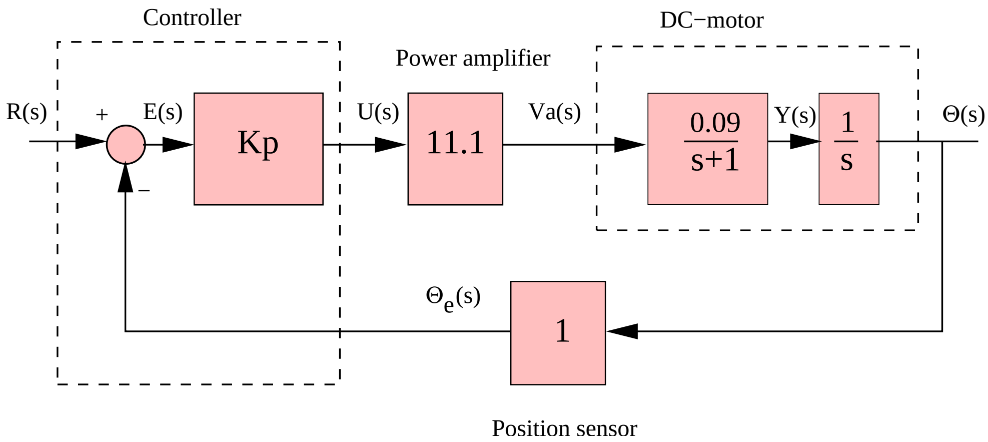

Figure 1: *Position controlled motor, P-controller*

   velocity, $Y(s)$. The transfer function from velocity, $Y(s)$, to shaft position, $\theta(s)$, is defined as an integration. A position controlled motor is shown in the figure.

   - Find the K_P giving 20 % overshoot (M_P).
   - Giving this K_P determine the rise time (t_r) and settling time (t_s) (2 %)
   - What is the system type? Determine the steady state errors for a step, a ramp and a parabola.

2. Transient reponse, system type and steady state errors (two controllers).

   Another position control of the DC-motoren is shown in the figure.

   - Determine the closed loop transfer function $T(s) = \frac{\Theta(s)}{R(s)}$.
   - Find the K_1 and K_2 that gives an overshoot (M_P) equal 20 % and a settling time (2%) (t_s) equal 1 [sec].
   - Find the rise time (t_r) of the system?
   - What is the system type? Determine the steady state errors for a step, a ramp and a parabola.

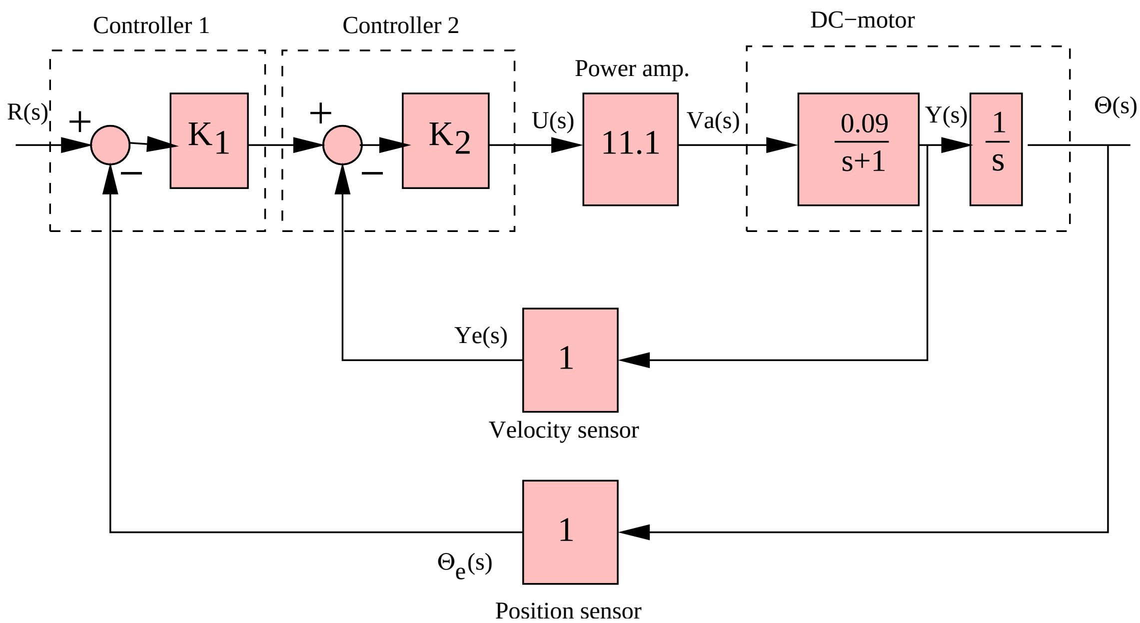

Figure 2: *Position controlled motor, two controllers*

3. Transient response, system type and steady state errors (PD-controller).

   On the figure a PD-controlled DC-motor is shown.

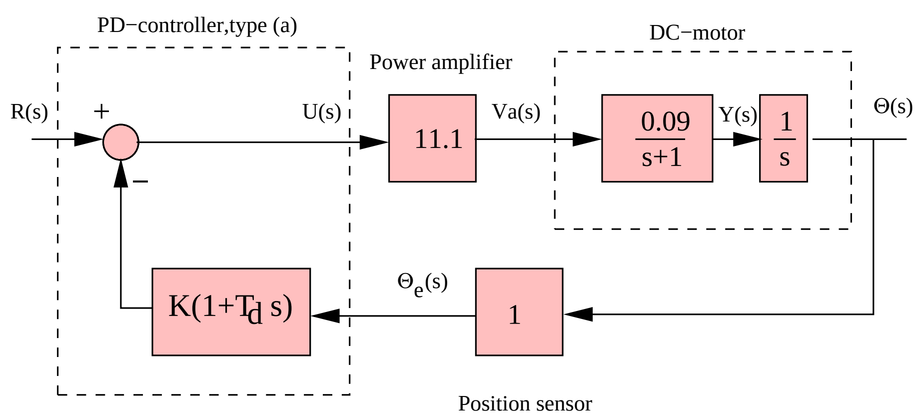

Figure 3: *Position controlled motor, PD-controller*

- Determine K and T_d giving an overshoot (M_P) of 20 % and a settling time (t_s)(2%) equal to 1 [sec].
- Find the rise time (t_r).
- What is the system type? Determine the steady state errors for a step, a ramp and a parabola.

4. Step response analyses %

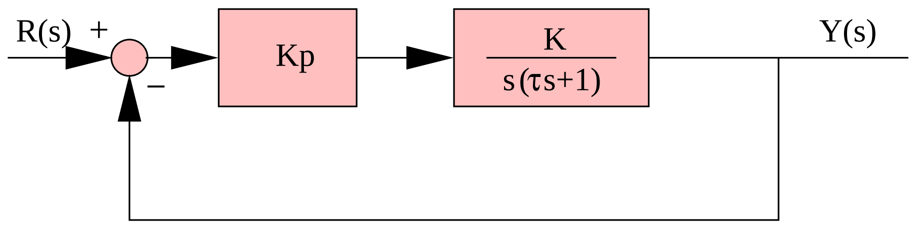

Figure 4: *Block diagram of a proportional-controlled system*

- With known $\tau > 0$ and $K > 0$ an expression for K_p giving 10 % overshoot must be determined. So find K_p given by τ and K.