Chapter 5

5.1 Joint Actuation System

- Usually has:
  - Power supply
  - Power amplifier
  - Servomotor
  - Transmission

P_c = power associated w/control law
P_u = mechanical power to joint
P_a = supply power of motor
P_p = power provided by primary source
P_m = power developed by motor

P_{da}, P_{ds}, P_{dt} = power dissipated by: amplifier, motor, transmission

5.1.1 Transmissions

- Execution of joint motions requires low speed, high torques
  transmission between motor + joint

Types: spur gears : modify rotational axis and/or translation point
lead screws : convert rotation to translation
timing belts : locates motor remotely on axis of joint

5.1.2. Servomotors

Actuation of joint motions
hydraulic, pneumatic, or electric
difficult accuracy
most popular

5.1.3 Power Amplifiers

Choppers : DC-DC converter

5.2 Drives

5.2.1 Electric Drives

$$V_a = (R_a + sL_a)I_a + V_g$$

$$V_g = k_v \Omega_m$$

V_a = armature voltage
I_a = armature current
R_a = armature resistance
L_a = armature inductance

V_g = back EMF ($\propto$ to $\measuredangle$ velocity)
Ω_m = $\measuredangle$ velocity of motor
K_v = voltage constant

Mechanical balance

$$C_m = (sI_m + F_m)\Omega_m + C_l$$

$$C_m = K_T I_a$$

C_m = driving torque
C_l = load reaction torque

I_m = moment of inertia
F_m = viscous friction coeff

$K_T = K_V$ in SI unit system

$$\frac{V_a}{V_c} = \frac{G_v}{1 + sT_v}$$

G_v = voltage gain
T_v = time constant (can be neglected)

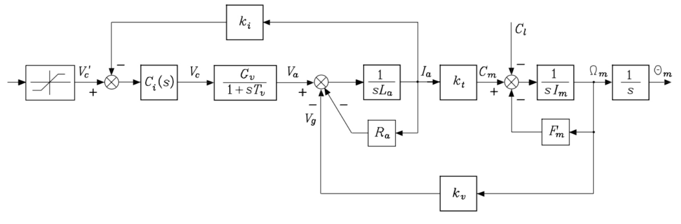

Fig. 5.2. Block scheme of an electric drive

$C_i(s)$ = current regulator
this choice allows velocity-controlled or torque controlled

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