

# 1 POG modeling of a planetary gear: only elastic part

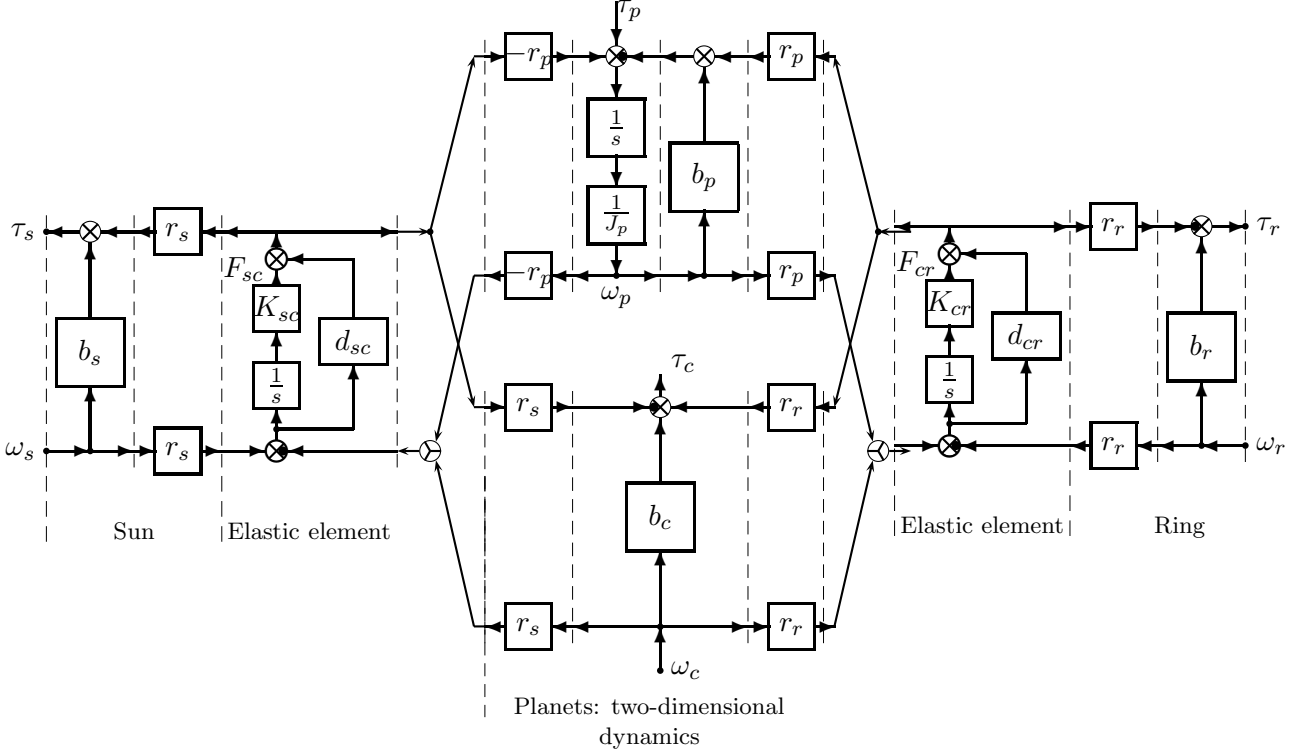


Figure 1: The POG model of the considered elastic planetary gear: the sun, the planets and the ring interact through elastic elements.

The POG state space dynamic model of the considered planetary gear: only the inputs  $\omega_s$ ,  $\omega_c$  and  $\omega_r$  have been considered.

$$\underbrace{\begin{bmatrix} \frac{1}{K_{sc}} & 0 & 0 \\ 0 & J_p & 0 \\ 0 & 0 & \frac{1}{K_{cr}} \end{bmatrix}}_{\bar{\mathbf{L}}} \underbrace{\begin{bmatrix} \dot{F}_{sc} \\ \dot{\omega}_p \\ \dot{F}_{cr} \end{bmatrix}}_{\bar{\dot{\mathbf{x}}}} = - \underbrace{\begin{bmatrix} 0 & -r_p & 0 \\ r_p & r_p^2 d_{sc} + b_p + r_p^2 d_{cr} & r_p \\ 0 & -r_p & 0 \end{bmatrix}}_{\bar{\mathbf{A}}} \underbrace{\begin{bmatrix} F_{sc} \\ \omega_p \\ F_{cr} \end{bmatrix}}_{\bar{\mathbf{x}}} + \underbrace{\begin{bmatrix} r_s & -r_s & 0 \\ -r_s d_{sc} r_p & r_s d_{sc} r_p - r_r d_{cr} r_p & r_r d_{cr} r_p \\ 0 & r_r & -r_r \end{bmatrix}}_{\bar{\mathbf{B}}} \underbrace{\begin{bmatrix} \omega_s \\ \omega_c \\ \omega_r \end{bmatrix}}_{\mathbf{u}}$$

$$\underbrace{\begin{bmatrix} \tau_s \\ \tau_c \\ \tau_r \end{bmatrix}}_{\bar{\mathbf{y}}} = \underbrace{\begin{bmatrix} r_s & r_s d_{sc} r_p & 0 \\ -r_s & 0 & r_r \\ 0 & -r_r d_{cr} r_p & -r_r \end{bmatrix}}_{\bar{\mathbf{C}}} \underbrace{\begin{bmatrix} F_{sc} \\ \omega_p \\ F_{cr} \end{bmatrix}}_{\bar{\mathbf{x}}} + \underbrace{\begin{bmatrix} b_s + r_s^2 d_{sc} & -r_s^2 d_{sc} & 0 \\ -r_s^2 d_{sc} & b_c + r_s^2 d_{sc} + r_r^2 d_{cr} & -r_r^2 d_{cr} \\ 0 & -r_r^2 d_{cr} & b_r + -r_r^2 d_{cr} \end{bmatrix}}_{\bar{\mathbf{D}}} \underbrace{\begin{bmatrix} \omega_s \\ \omega_c \\ \omega_r \end{bmatrix}}_{\mathbf{u}}$$