

Università degli Studi di Padova – Dipartimento di Ingegneria Industriale

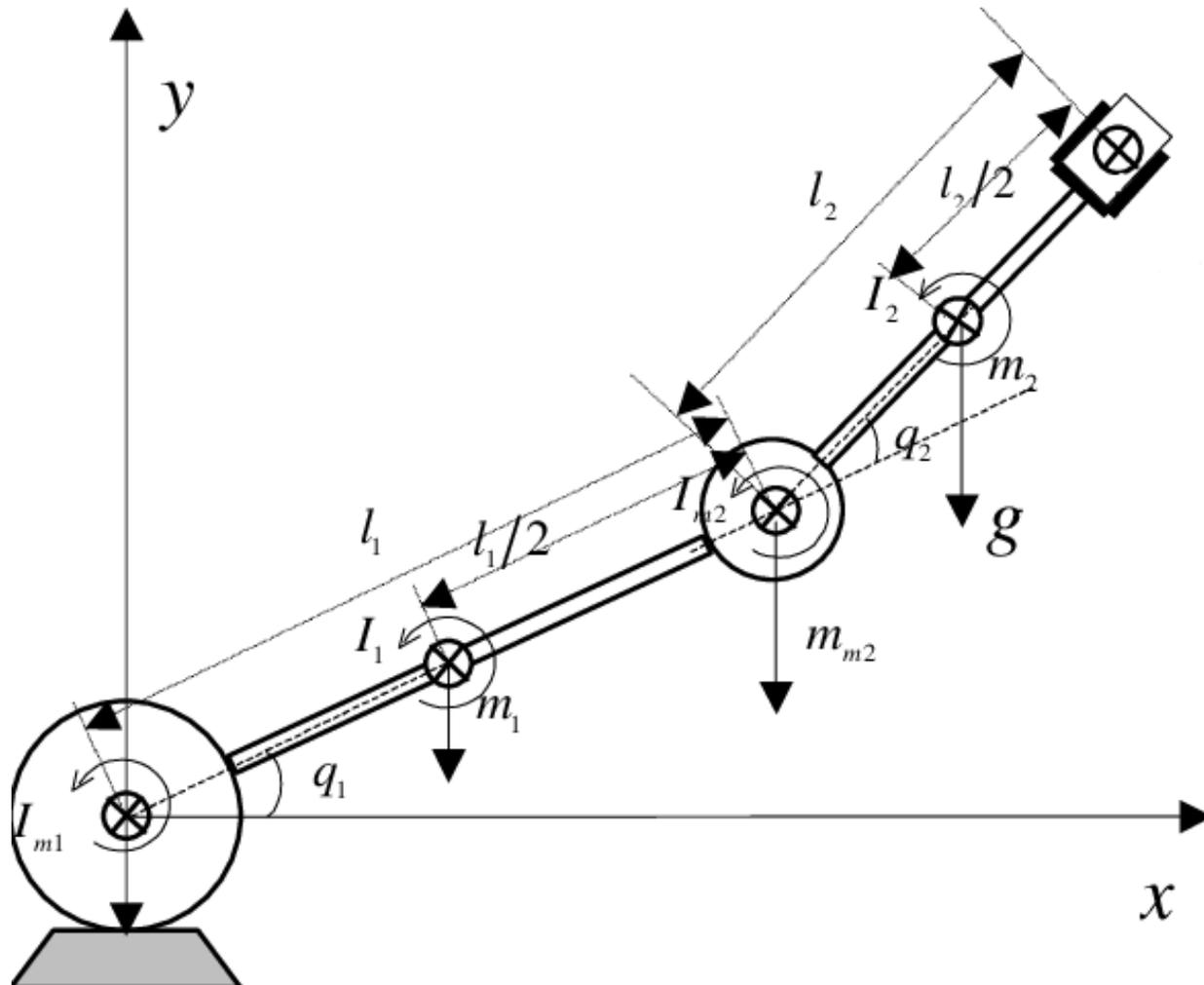
Corso di Laurea in Ingegneria ...

***Relazione per la prova finale
«Controllo di un braccio robotico su
piano»***

Tutor universitario: Prof. Alessandro Beghi

Laureando: *Matteo Zampieri*

Padova, 15/07/2022

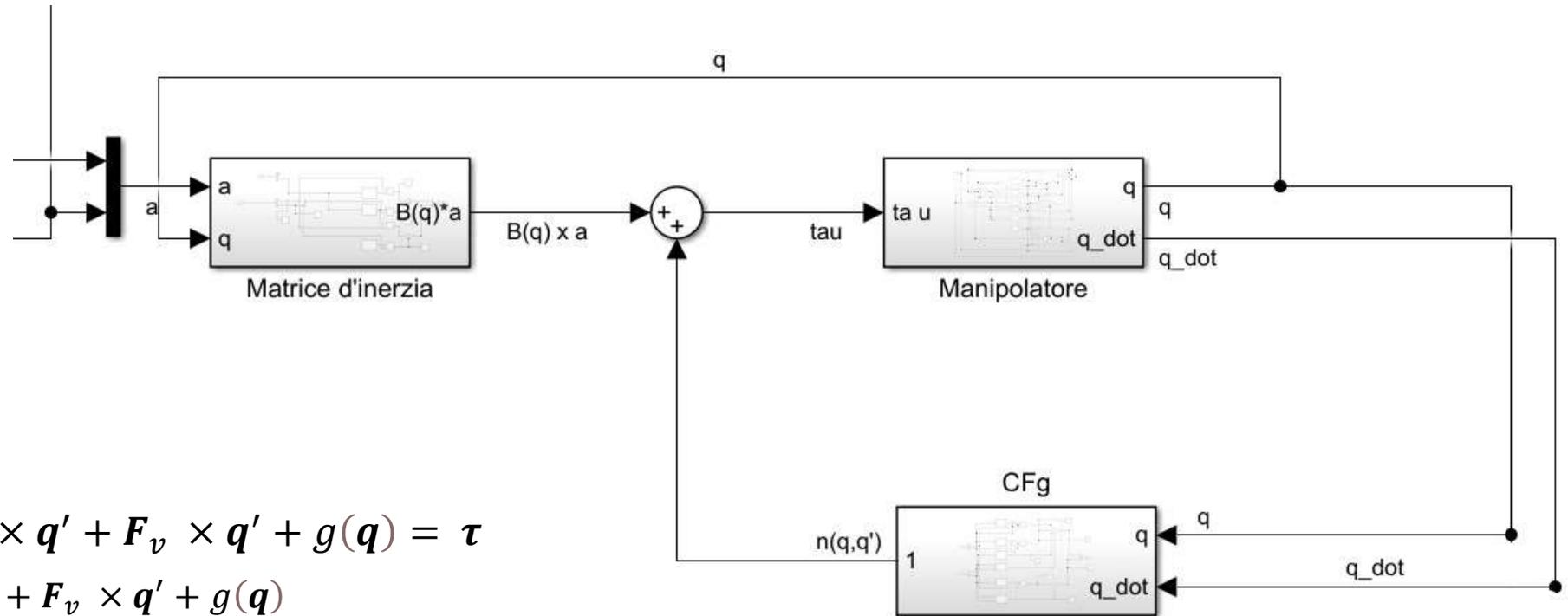


1) Obiettivo di controllo: far fare al terminale la traiettoria desiderata;

2) Scelta di controllo: Tipo Centralizzato;

3) Manipolatore:

- sistema MIMO non lineare;
- le variabili interagiscono tra di loro;
- Input : 2 coppie ai giunti
- Output : 2 posizioni dei giunti;



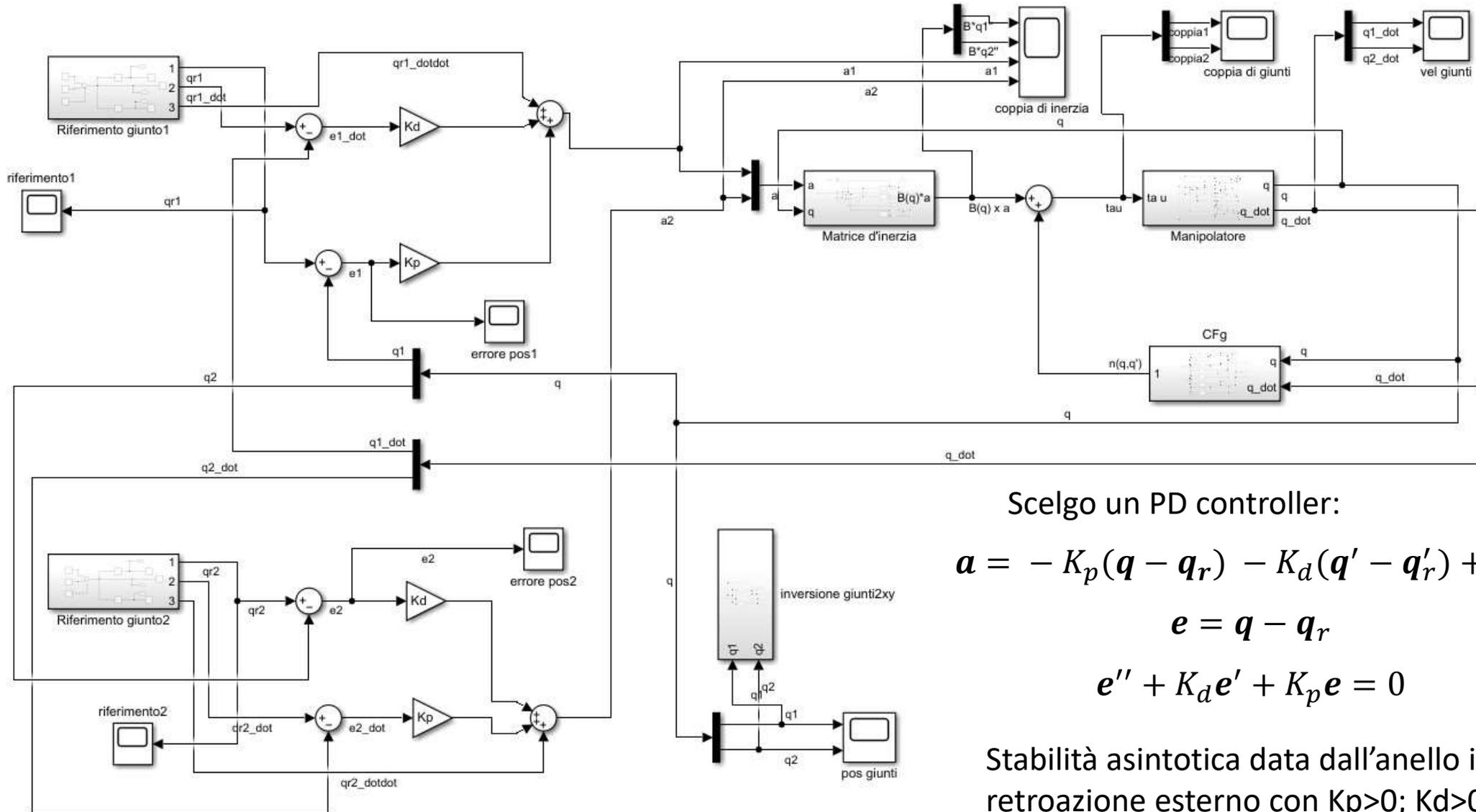
$$B(q) \times q'' + C(q', q) \times q' + F_v \times q' + g(q) = \tau$$

$$n(q', q) = C(q', q) \times q' + F_v \times q' + g(q)$$

$$a = q''$$

$$\tau = B(q) \times a + n(q', q)$$

Ora il sistema risulta lineare e disaccoppiato



Scelgo un PD controller:

$$a = -K_p(q - q_r) - K_d(q' - q_r') + q_r''$$

$$e = q - q_r$$

$$e'' + K_d e' + K_p e = 0$$

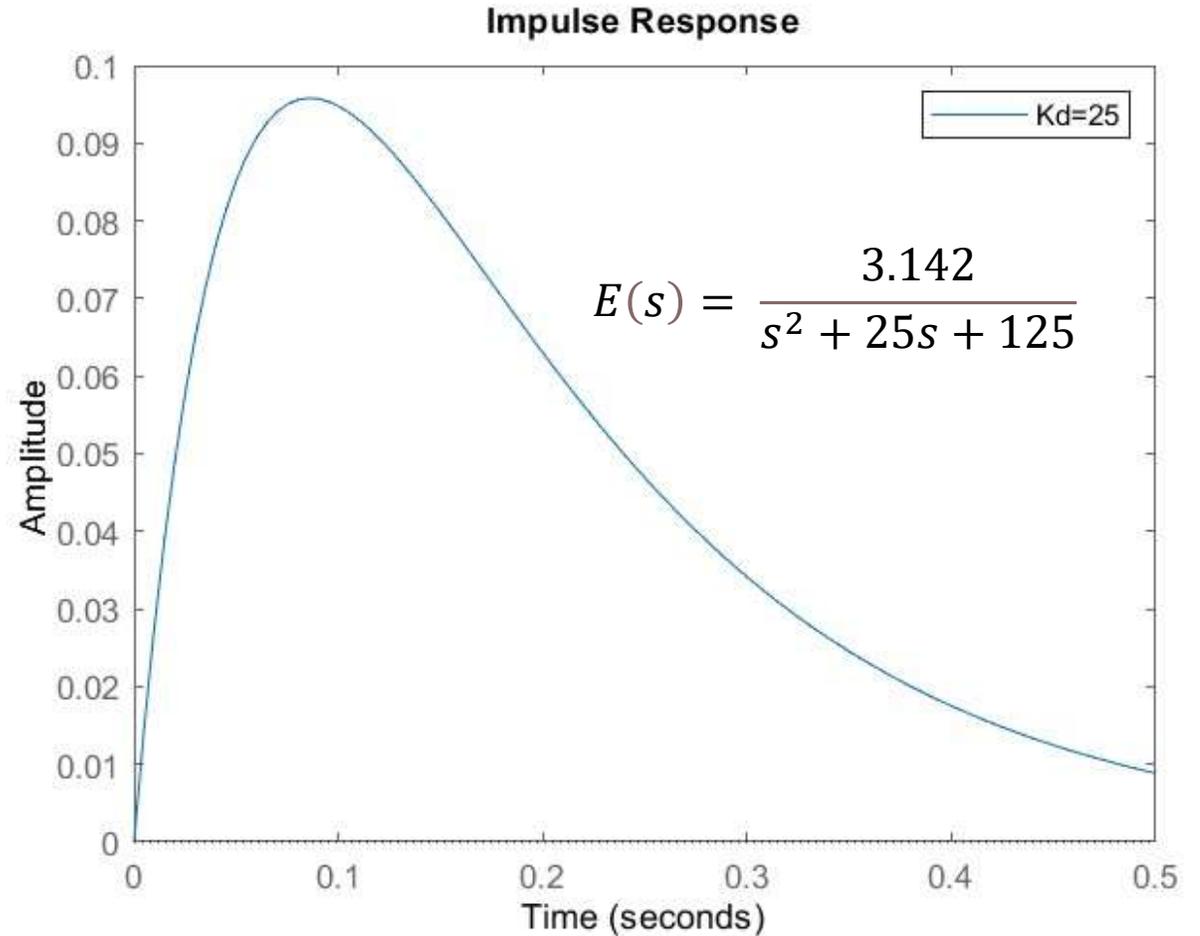
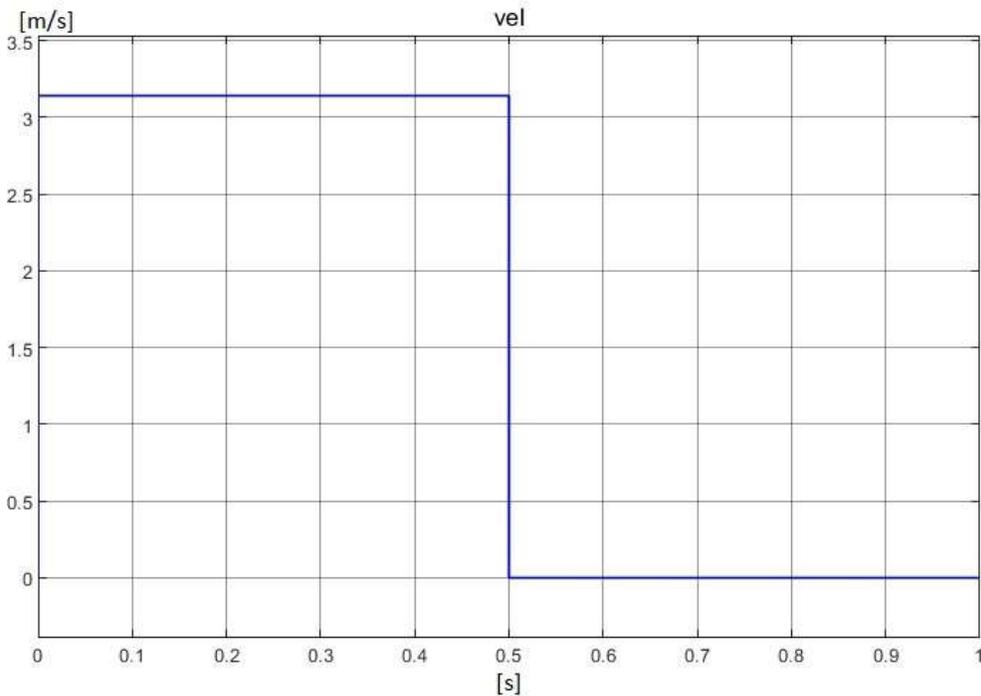
Stabilità asintotica data dall'anello in retroazione esterno con $K_p > 0$; $K_d > 0$;

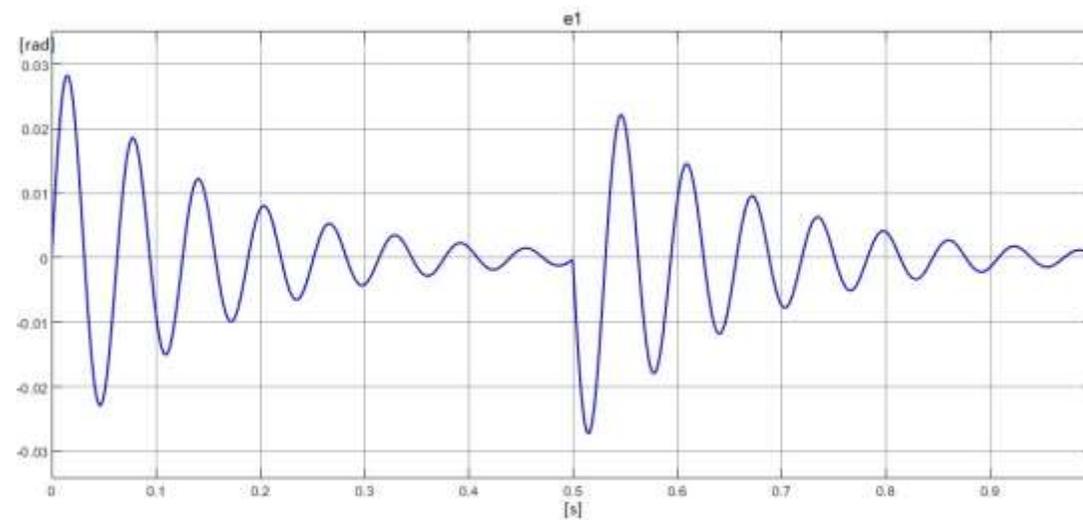
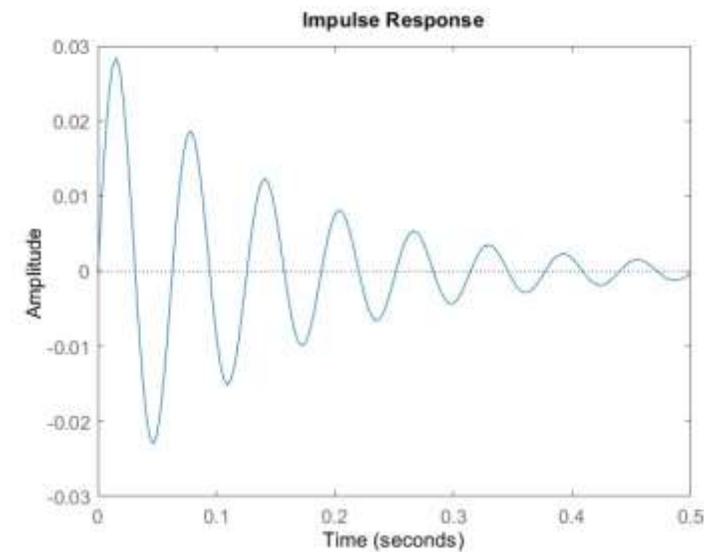
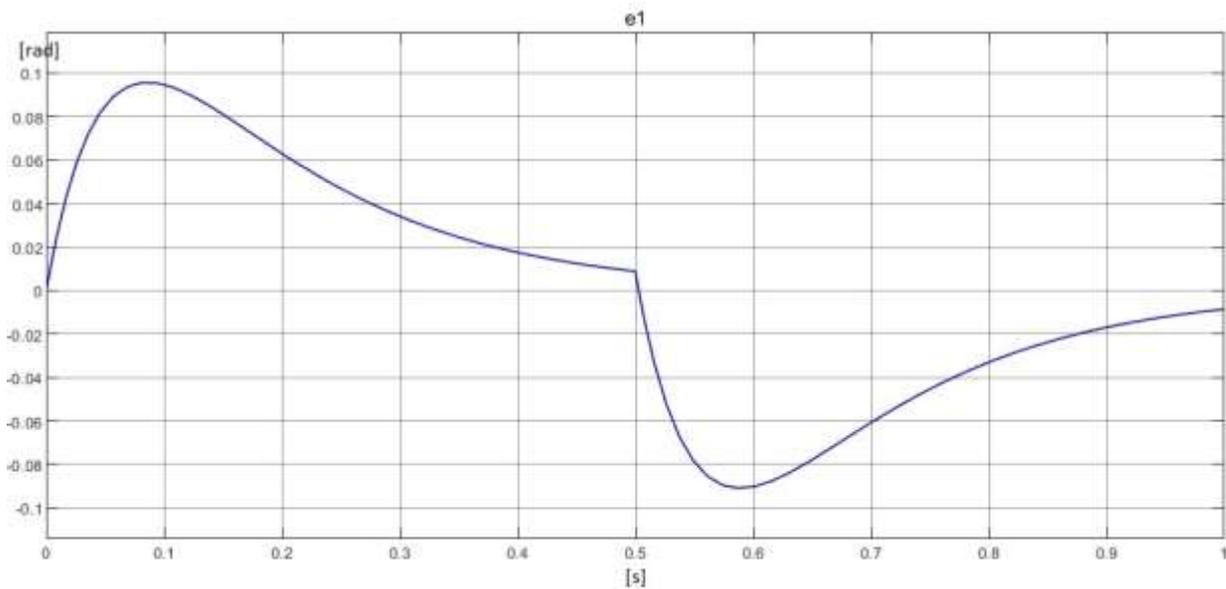
$$s^2 E(s) - se(0) - e'(0) + K_d[sE(s) - e(0)] + K_p E(s) = 0$$

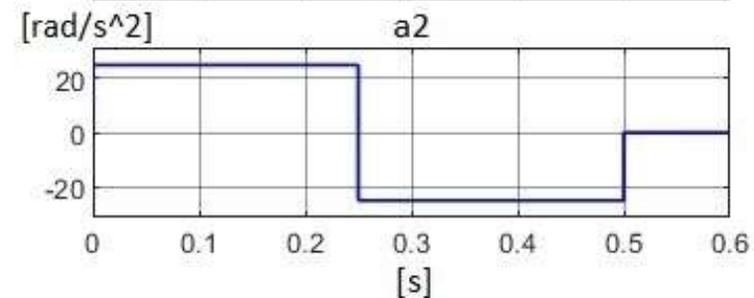
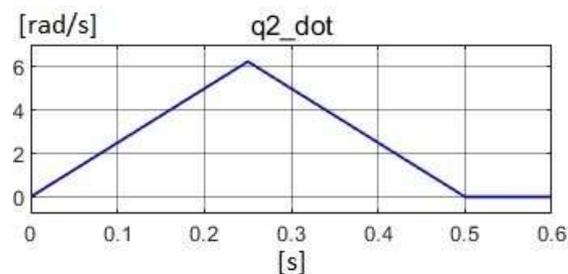
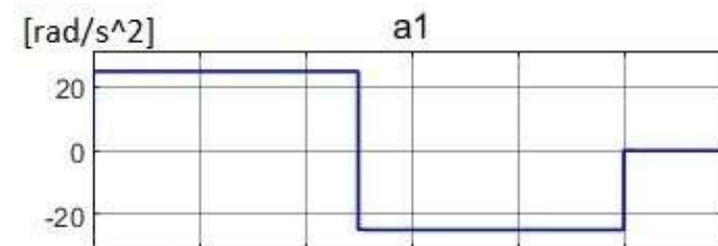
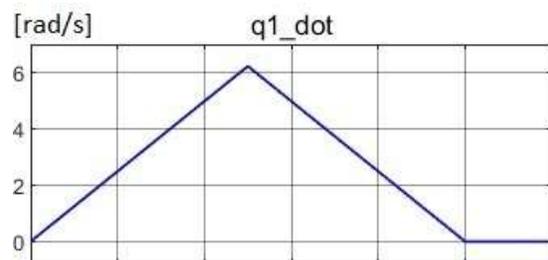
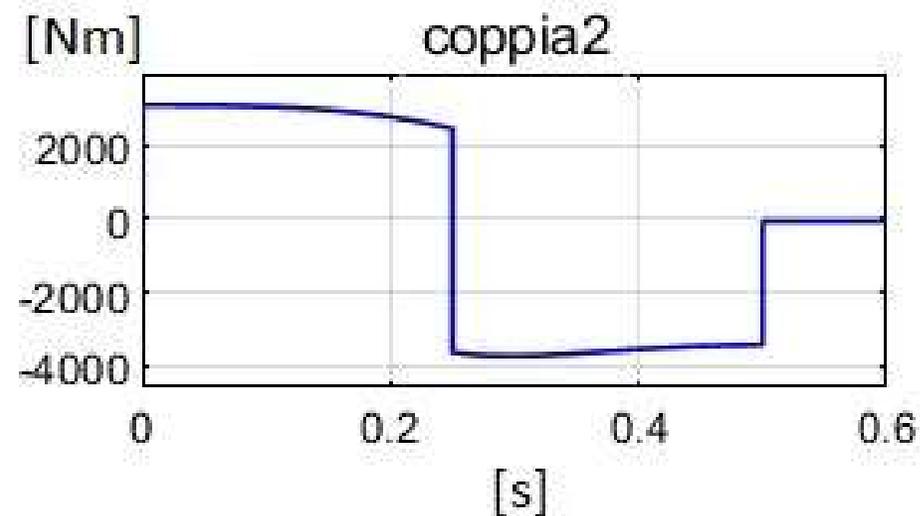
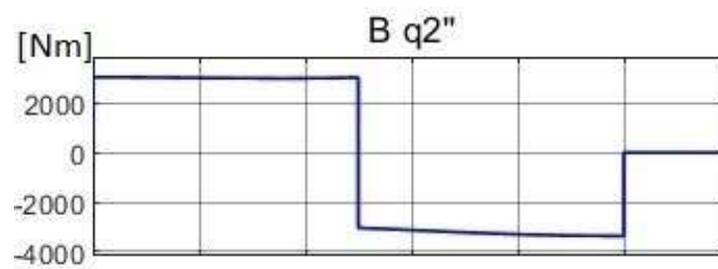
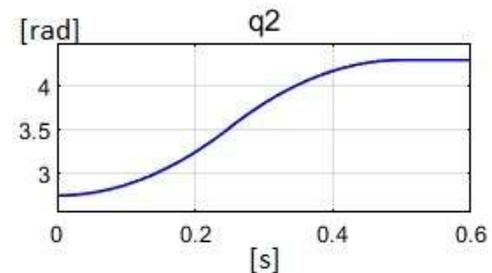
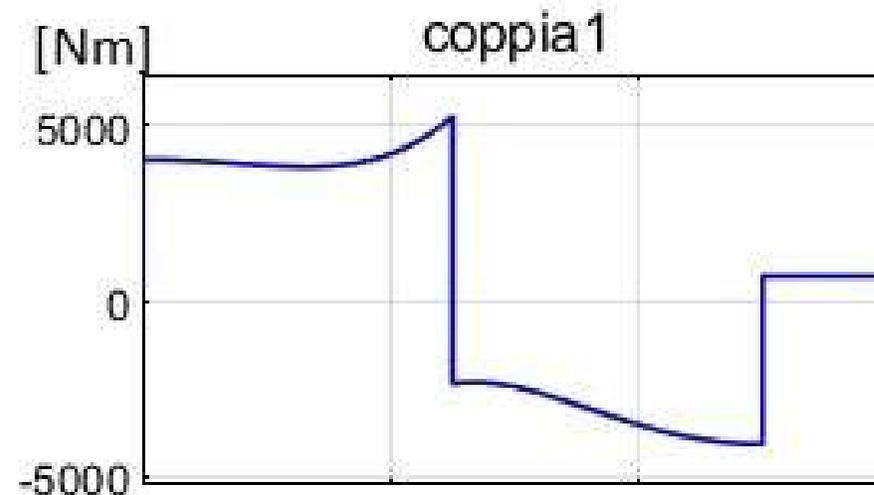
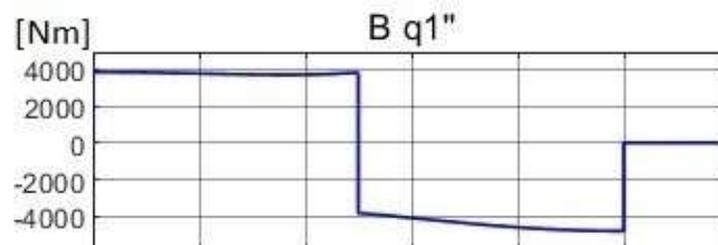
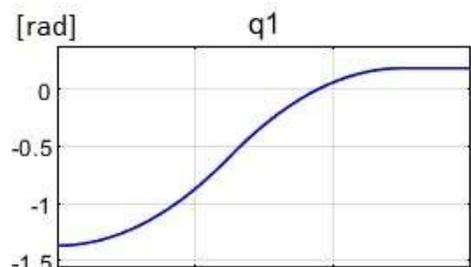
$$E(s) = \frac{e(0)[s + K_d] + e'(0)}{s^2 + K_d s + K_p}$$

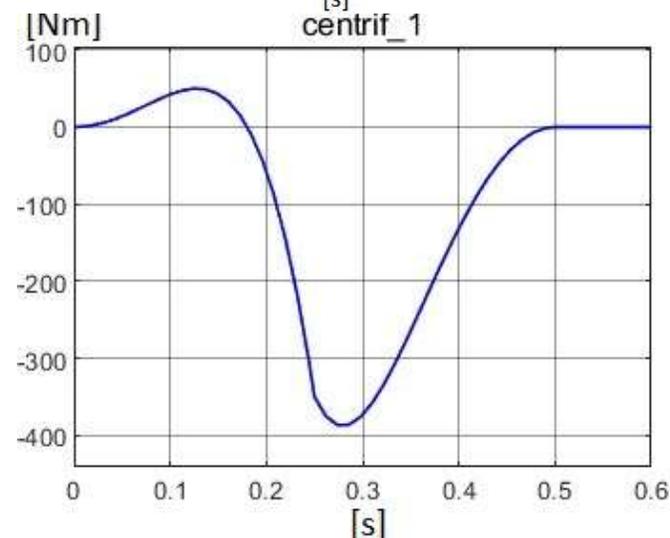
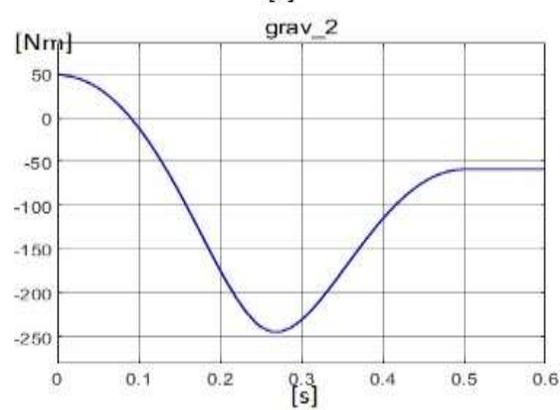
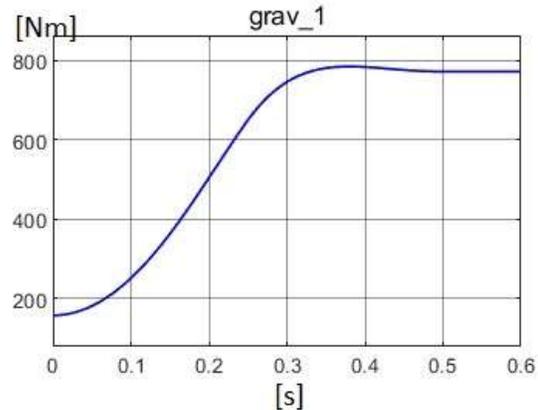
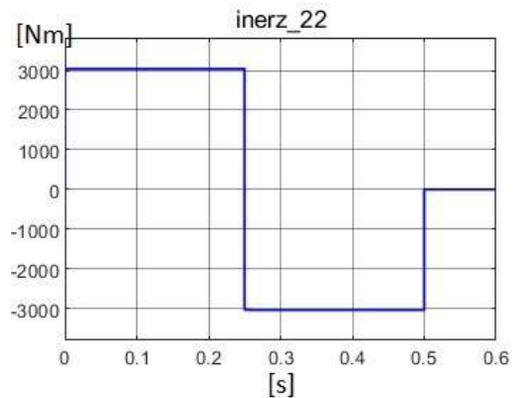
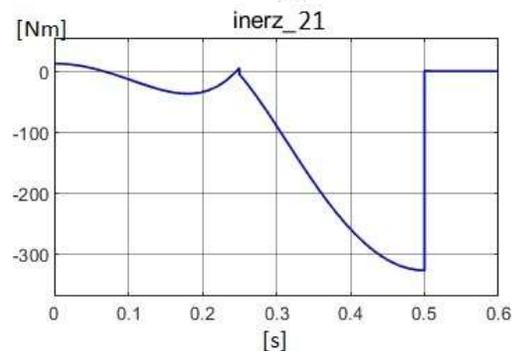
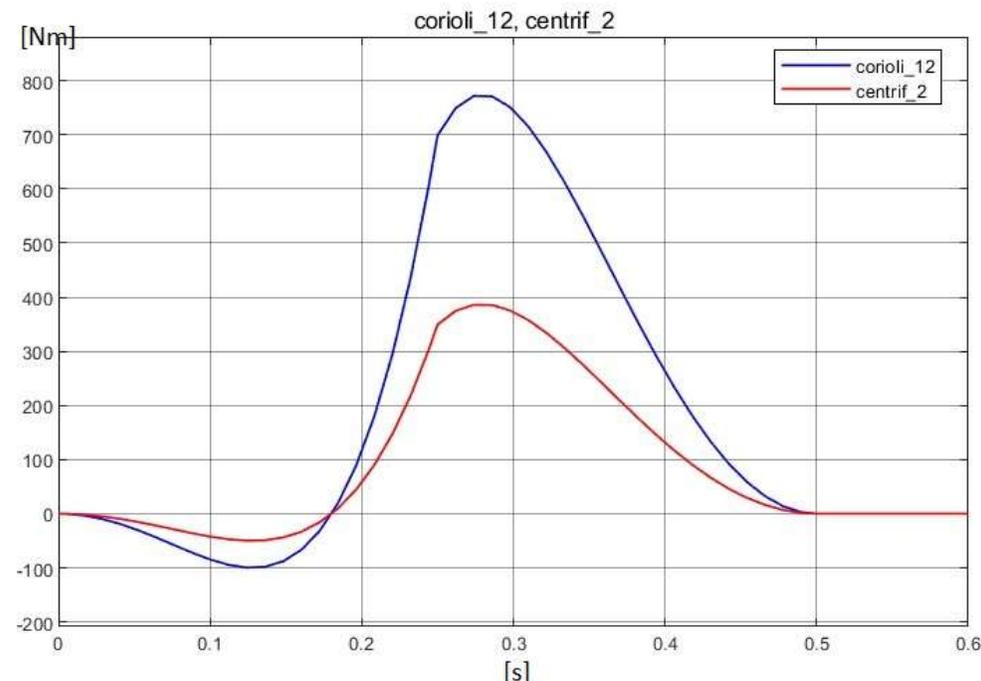
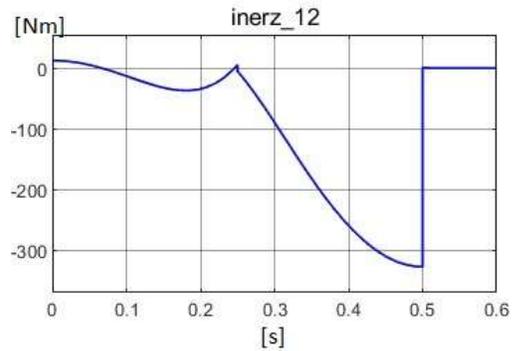
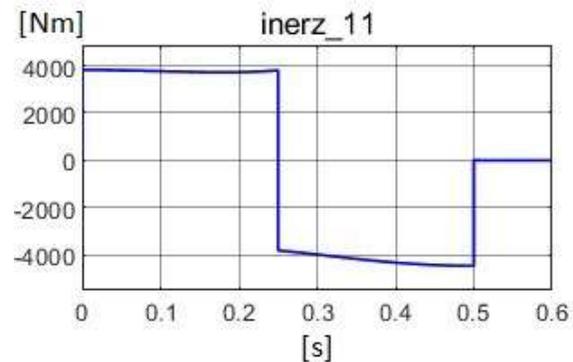
$$E(s) = \frac{e'(0)}{s^2 + K_d s + K_p}$$

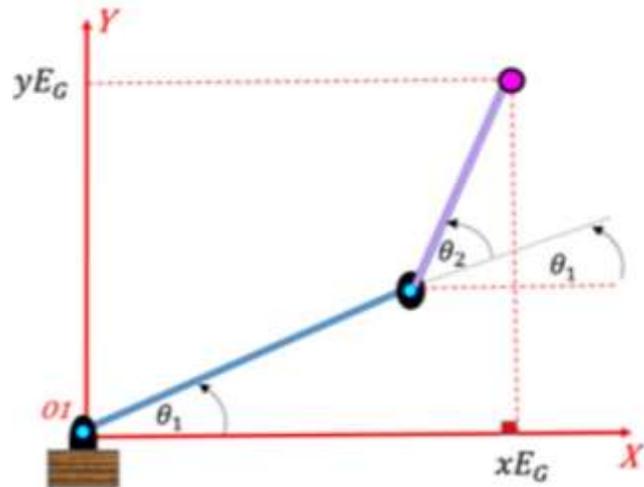
$$K_p < K_d^2/4 \text{ scelto } K_p = K_d^2/5$$







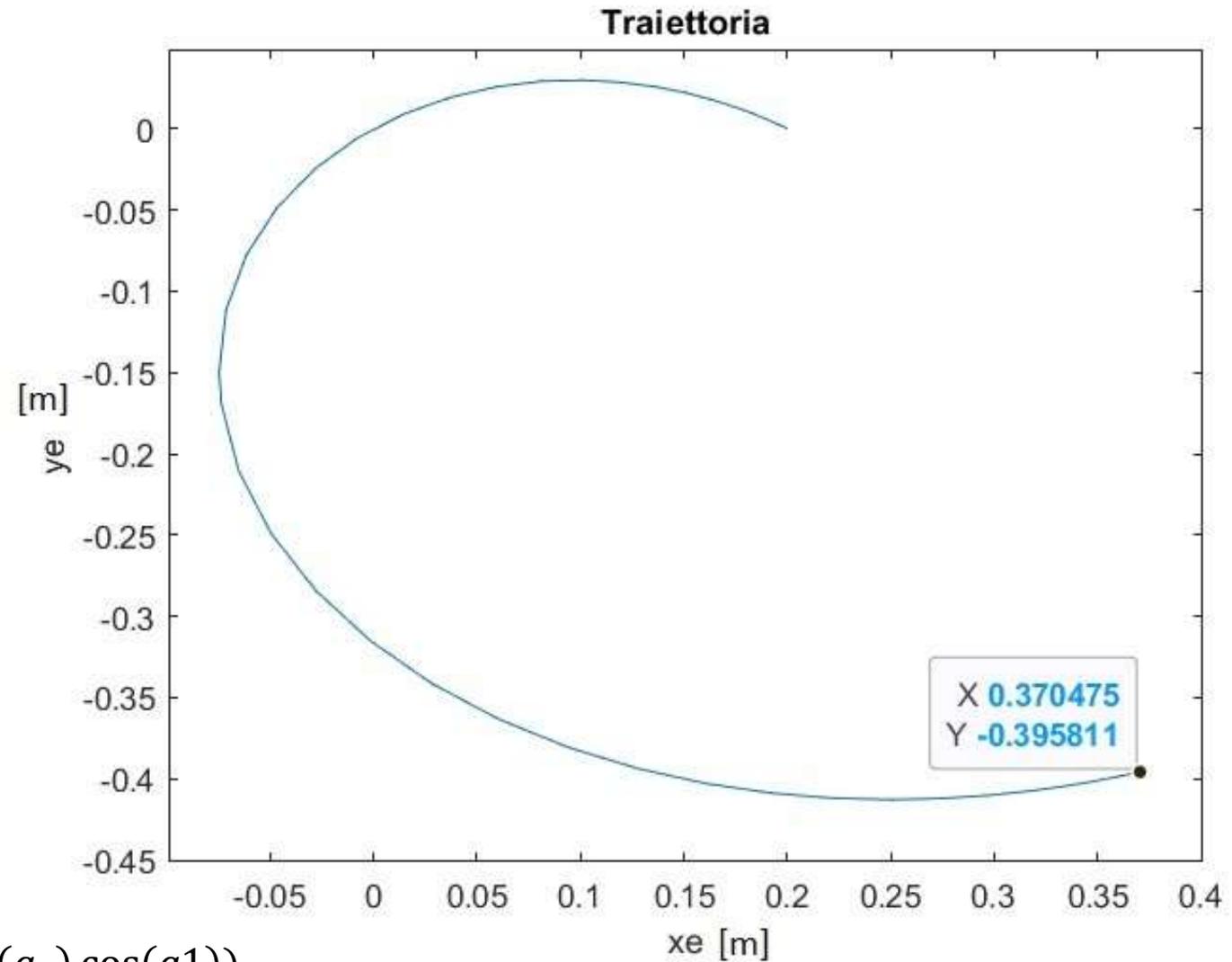


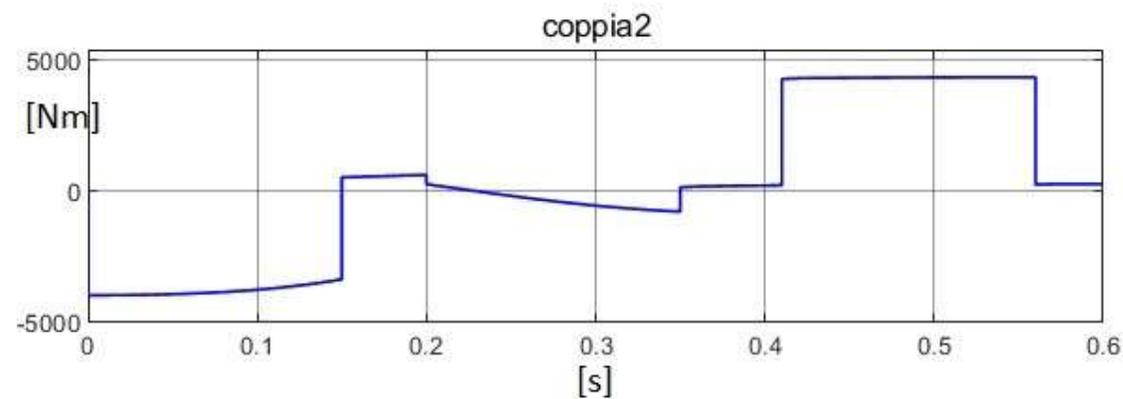
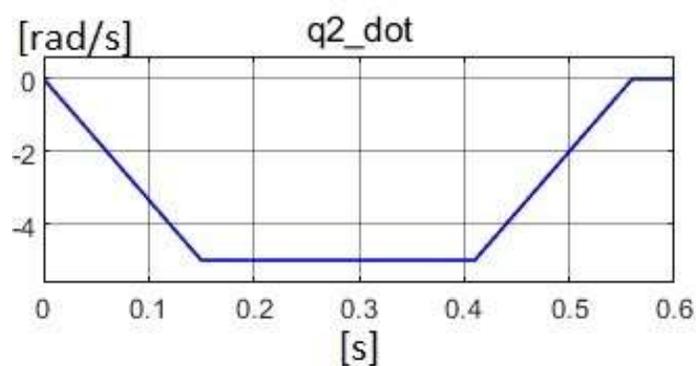
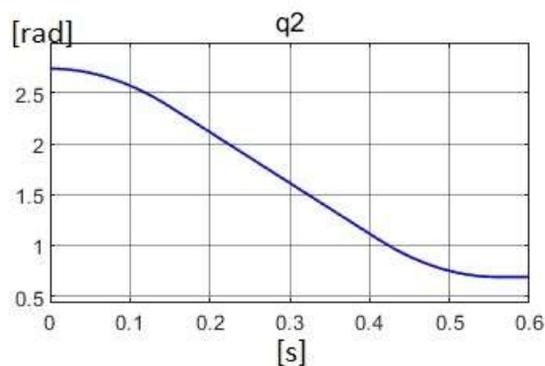
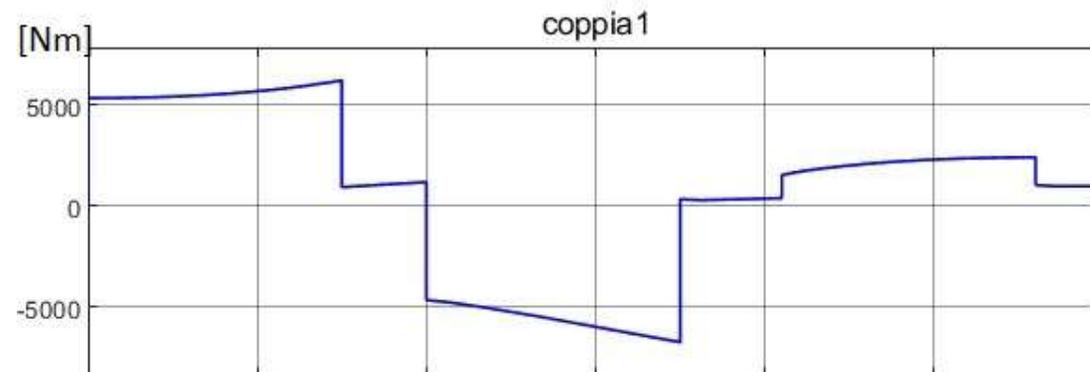
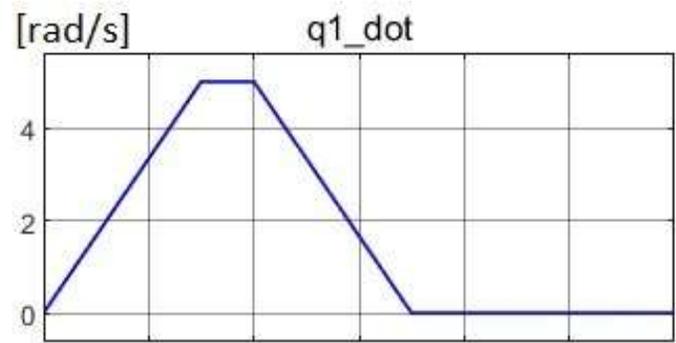
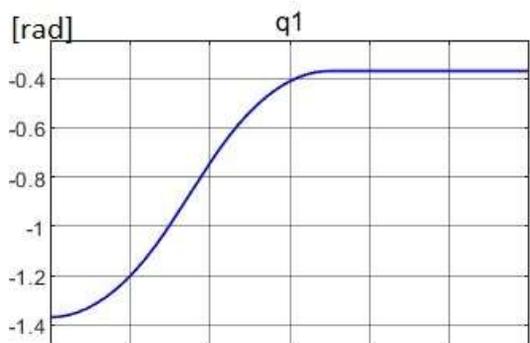


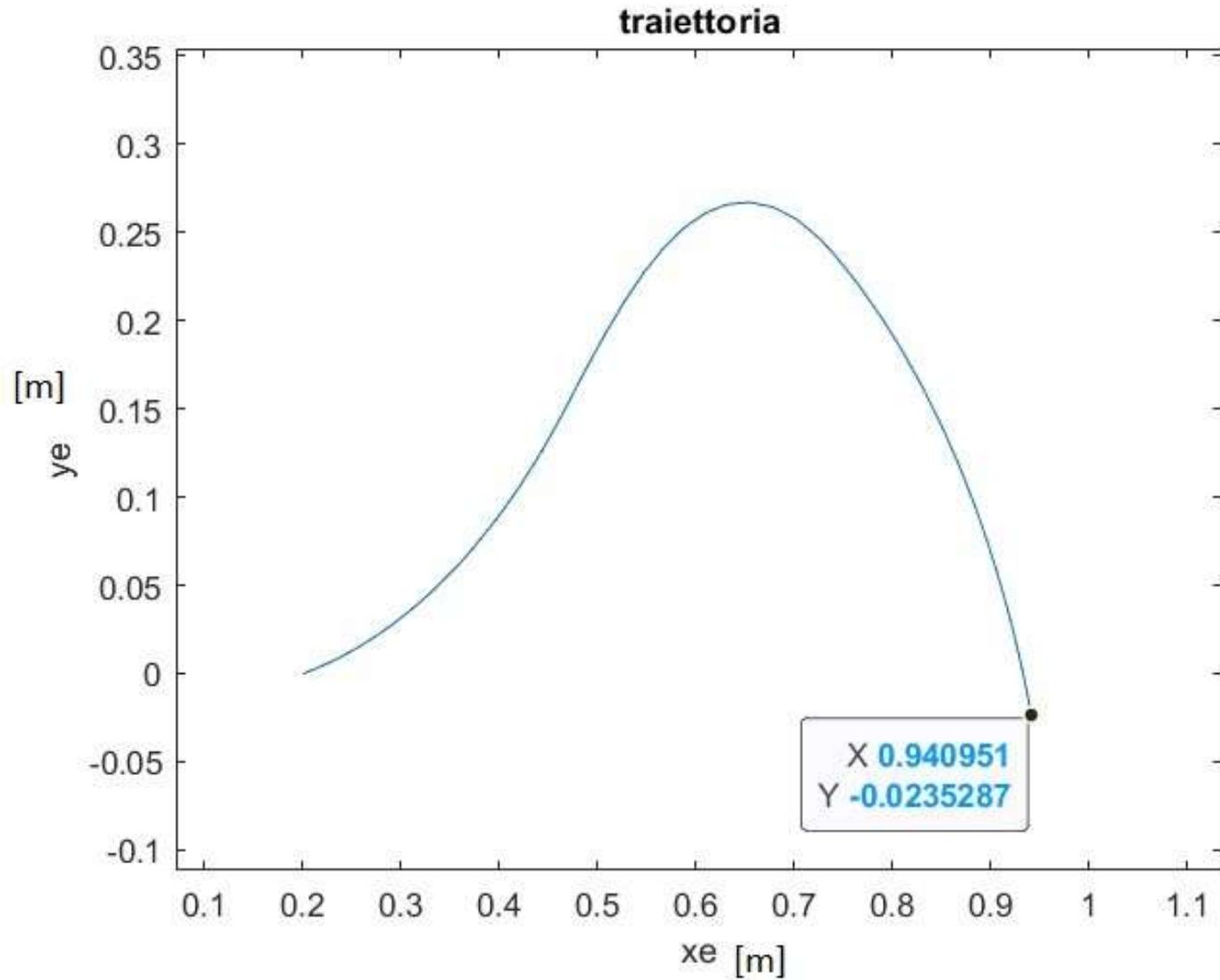
Var_giunto2Var_xy

$$x_e = l_1 \cos(q_1) + l_2 \cos(q_1 + q_2)$$

$$y_e = l_1 \sin(q_1) + l_2(\sin(q_1) \cos(q_2) + \sin(q_2) \cos(q_1))$$

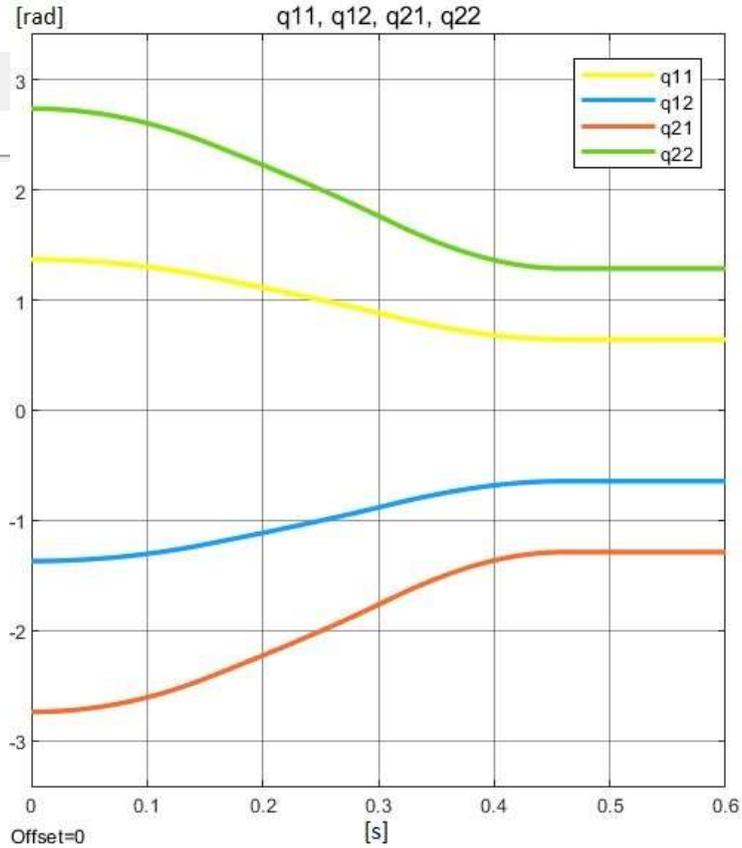
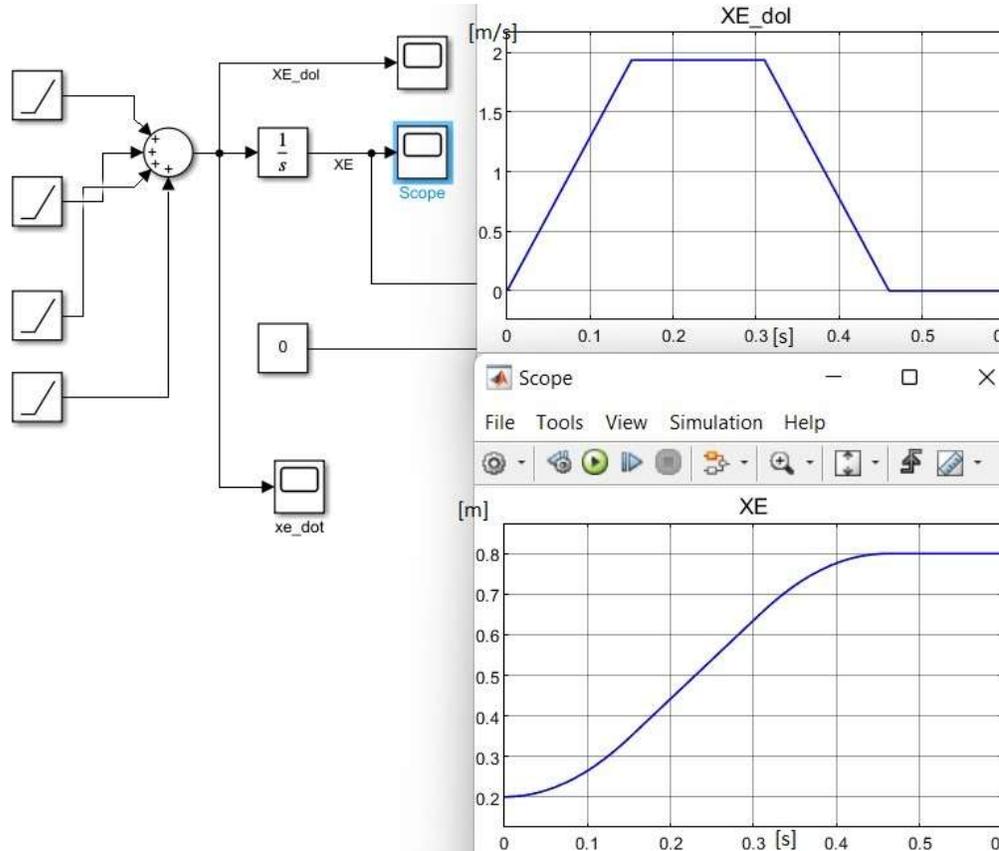




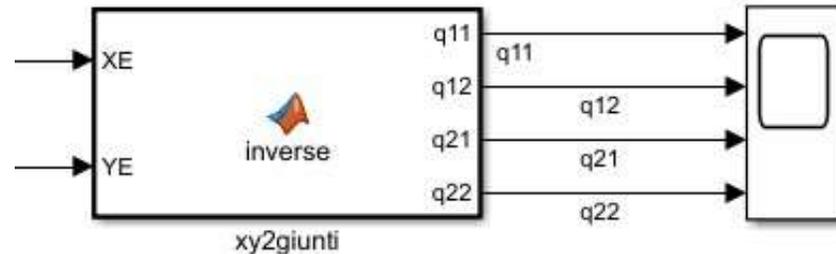


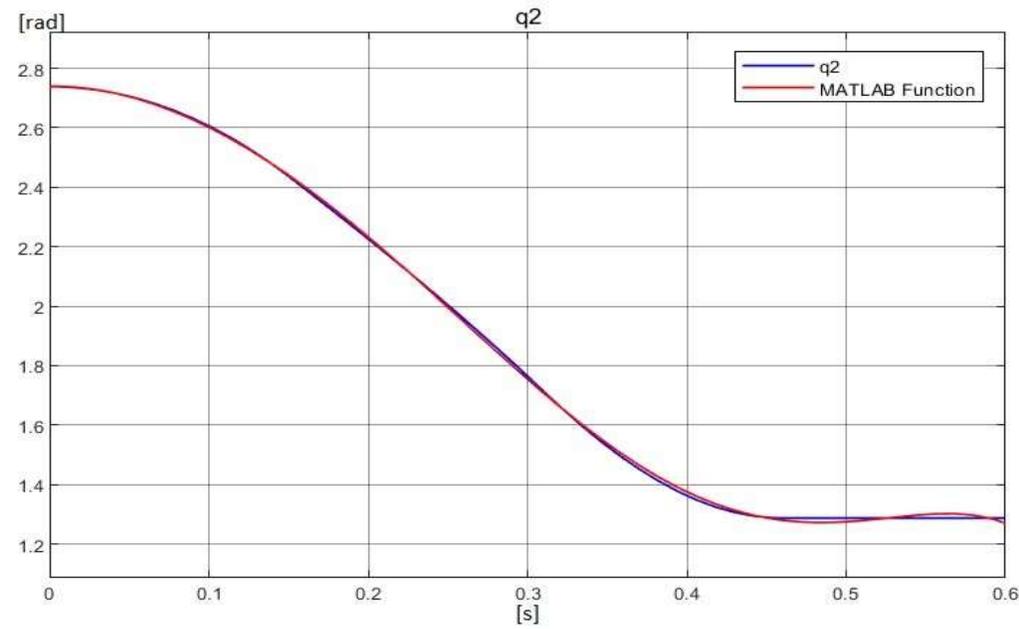
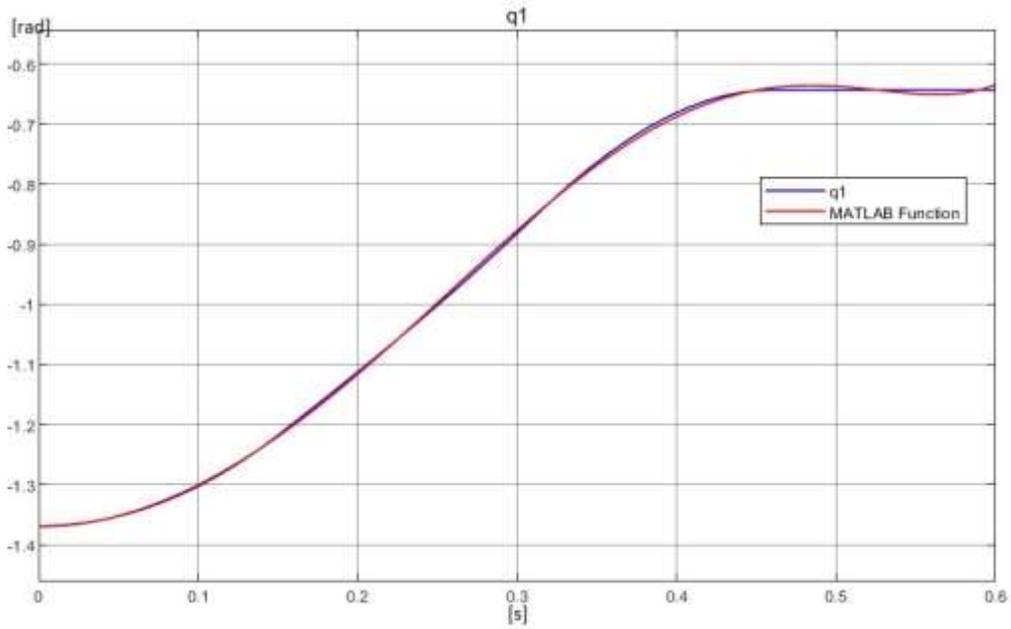
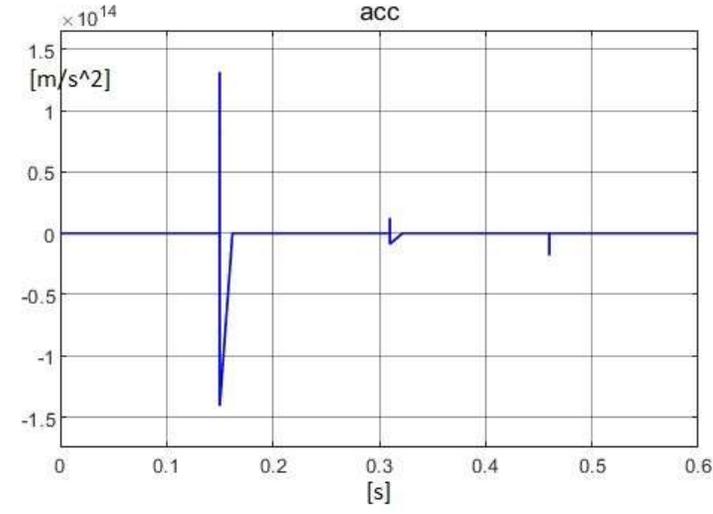
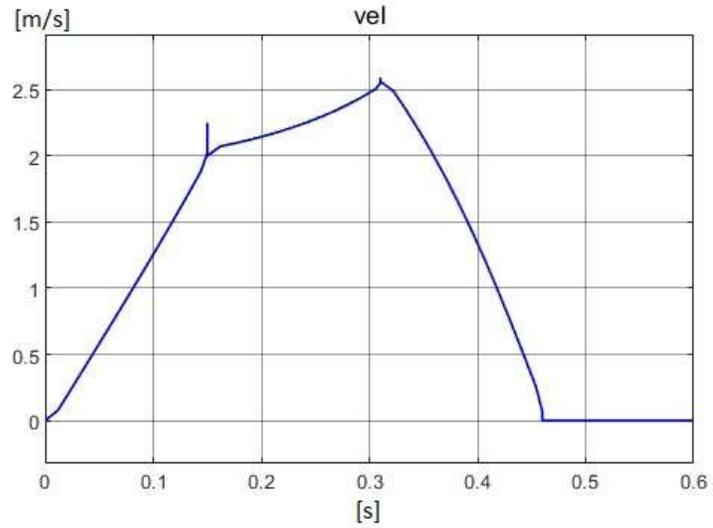
- Pos iniziale: (0.2,0) [m]
- Gomito basso

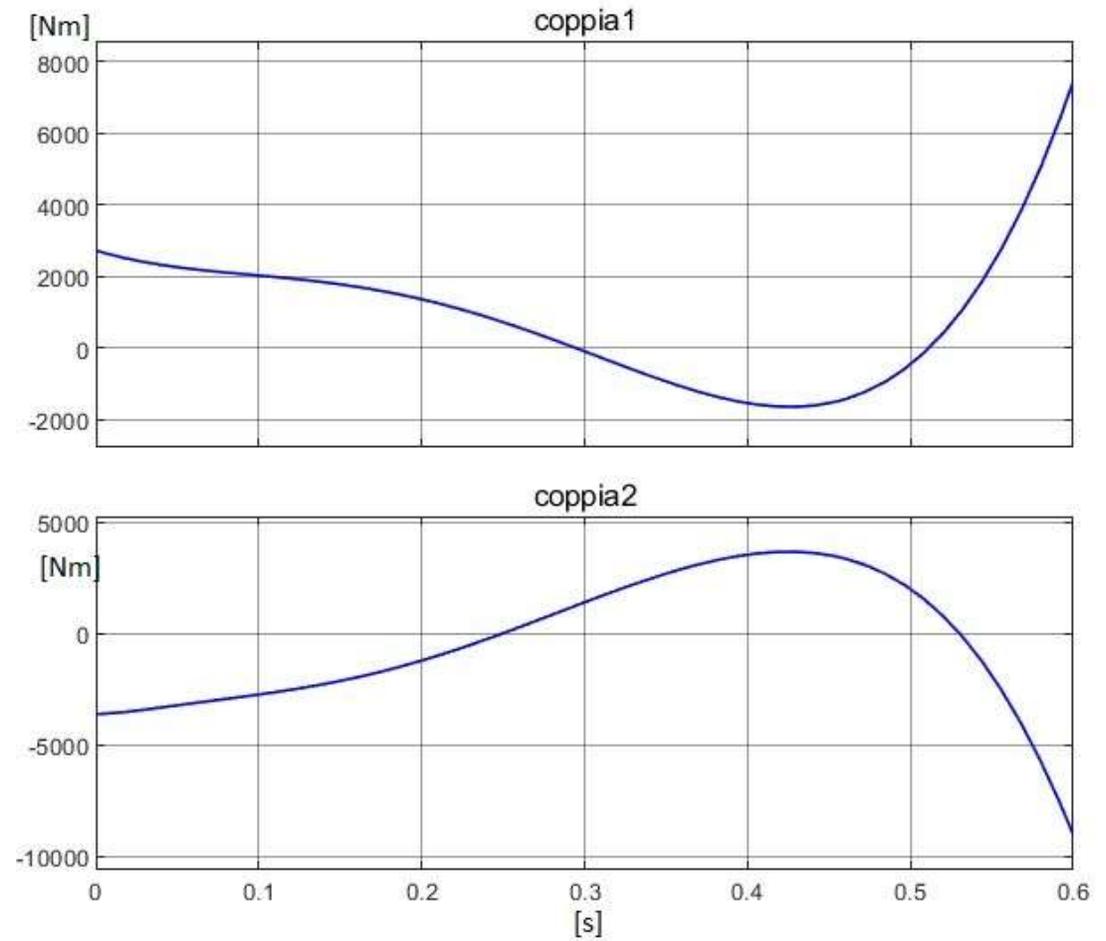
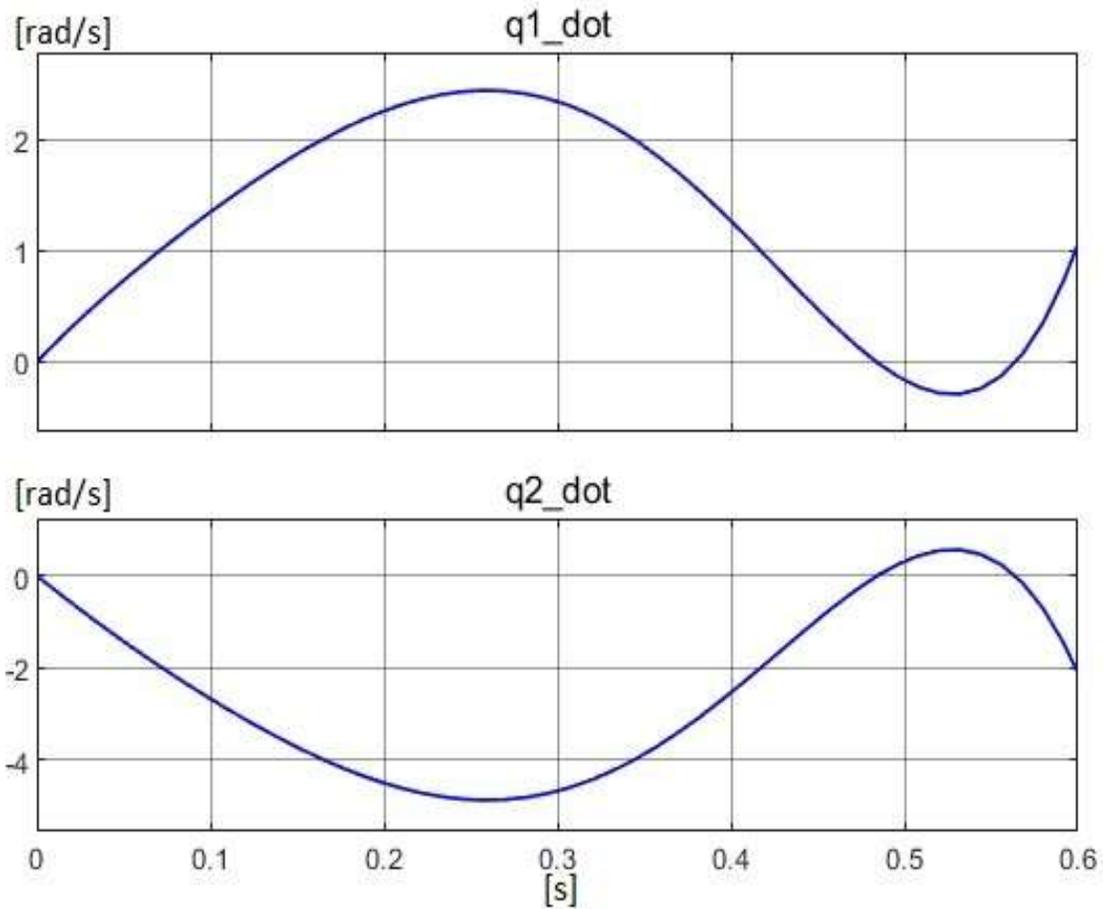
Initial condition:
2.7388



Initial condition:
-1.3694







Errore nullo garantito da $v(0)=0$;

