

## Moto forzato a regime con eccitazione armonica (3 gdl)

$ORIGIN := 1$

$$m_1 := 5 \quad k_1 := 1000 \quad c_1 := 15$$

$$m_2 := 8 \quad k_2 := 1200 \quad c_2 := 40$$

$$m_3 := 6 \quad k_3 := 500 \quad c_3 := 20$$

$$k_4 := 1500 \quad c_4 := 30$$

$$\mathbf{masse} := \begin{pmatrix} m_1 \\ m_2 \\ m_3 \end{pmatrix}$$

$$\mathbf{M} := \text{diag}(\mathbf{masse}) = \begin{pmatrix} 5 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 6 \end{pmatrix}$$

$$\mathbf{M} = \begin{pmatrix} 5 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 6 \end{pmatrix}$$

$$\mathbf{K} := \begin{bmatrix} (k_1 + k_2) & -k_2 & 0 \\ -k_2 & (k_2 + k_3) & -k_3 \\ 0 & -k_3 & (k_3 + k_4) \end{bmatrix}$$

$$\mathbf{K} = \begin{pmatrix} 2200 & -1200 & 0 \\ -1200 & 1700 & -500 \\ 0 & -500 & 2000 \end{pmatrix}$$

$$\mathbf{C} := \begin{bmatrix} (c_1 + c_2) & -c_2 & 0 \\ -c_2 & (c_2 + c_3) & -c_3 \\ 0 & -c_3 & (c_3 + c_4) \end{bmatrix}$$

$$\mathbf{C} = \begin{pmatrix} 55 & -40 & 0 \\ -40 & 60 & -20 \\ 0 & -20 & 50 \end{pmatrix}$$

### Pulsazioni proprie

$$\omega := \text{sort}(\sqrt{\text{eigenvals}(\mathbf{K}, \mathbf{M})}) = \begin{pmatrix} 9.419 \\ 18.538 \\ 23.526 \end{pmatrix}$$

$$\Omega := 30$$

$$f := \frac{\omega}{2 \cdot \pi} = \begin{pmatrix} 1.499 \\ 2.95 \\ 3.744 \end{pmatrix}$$

$$\mathbf{Z}(\Omega) := (\mathbf{K} - \Omega^2 \cdot \mathbf{M}) + i \cdot \Omega \cdot \mathbf{C}$$

$$\mathbf{Z}(\Omega) = \begin{pmatrix} -2300 + 1650i & -1200 - 1200i & 0 \\ -1200 - 1200i & -5500 + 1800i & -500 - 600i \\ 0 & -500 - 600i & -3400 + 1500i \end{pmatrix}$$

$$F_1 := 400$$

$$F_2 := 100$$

$$F_3 := 200$$

$$\psi_1 := 20 \cdot \text{deg} = 0.349 \cdot \text{rad}$$

$$\psi_2 := 40 \cdot \text{deg} = 0.698 \cdot \text{rad}$$

$$\psi_3 := 20 \cdot \text{deg} = 0.349 \cdot \text{rad}$$

$$\mathbf{F} := \begin{pmatrix} F_1 \cdot e^{i \cdot \psi_1} \\ F_2 \cdot e^{i \cdot \psi_2} \\ F_3 \cdot e^{i \cdot \psi_3} \end{pmatrix}$$

$$\mathbf{F} = \begin{pmatrix} 375.877 + 136.808i \\ 76.604 + 64.279i \\ 187.939 + 68.404i \end{pmatrix}$$

$$\mathbf{X}(\Omega) := \mathbf{Z}(\Omega)^{-1} \cdot \mathbf{F}$$

$$\mathbf{X}(\Omega) = \begin{pmatrix} -0.06425 - 0.10127i \\ -0.02954 + 0.0213i \\ -0.03283 - 0.03252i \end{pmatrix}$$

$$X_1 := |\mathbf{X}(\Omega)_1| = 0.12$$

$$X_2 := |\mathbf{X}(\Omega)_2| = 0.036$$

$$X_3 := |\mathbf{X}(\Omega)_3| = 0.046$$

$$\varphi_1 := \text{arg}(\mathbf{X}(\Omega)_1) = -2.136$$

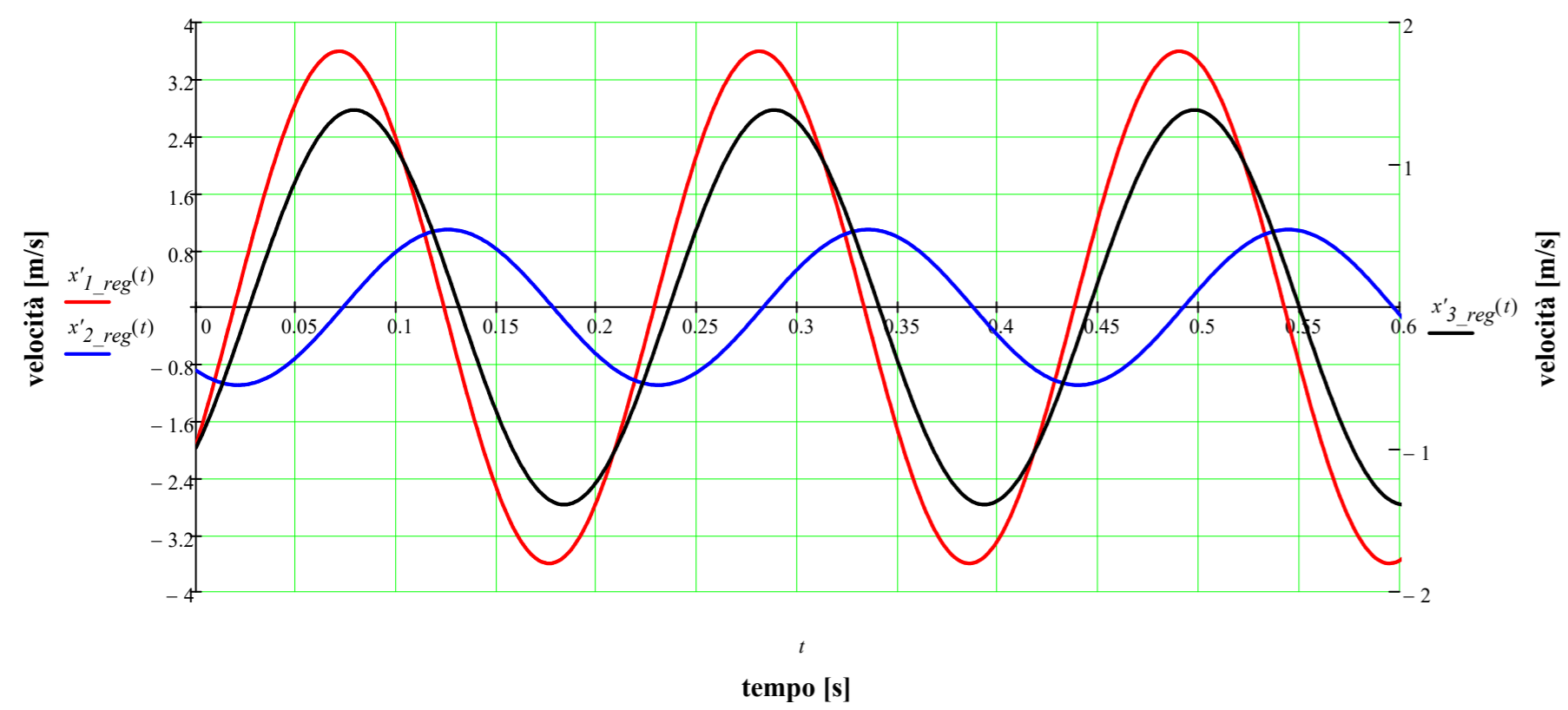
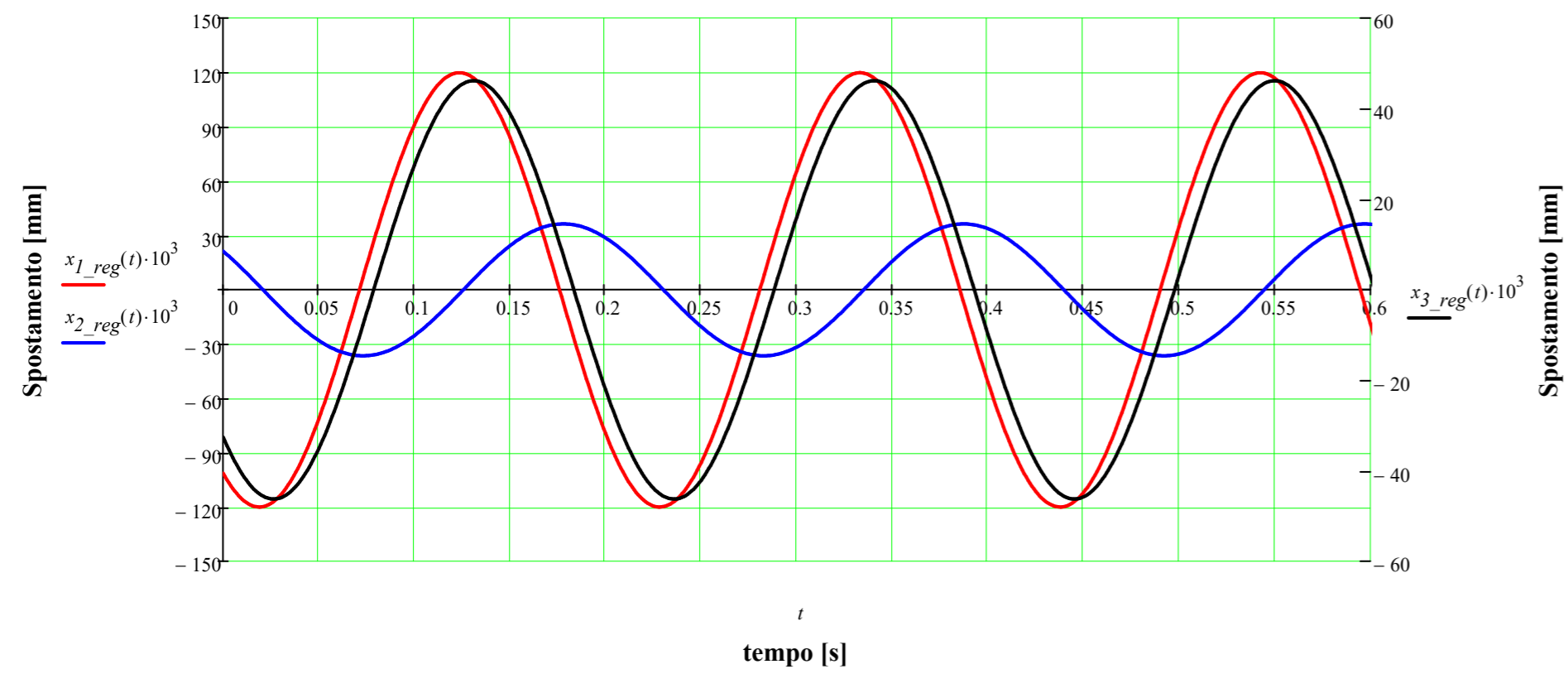
$$\varphi_2 := \text{arg}(\mathbf{X}(\Omega)_2) = 2.517$$

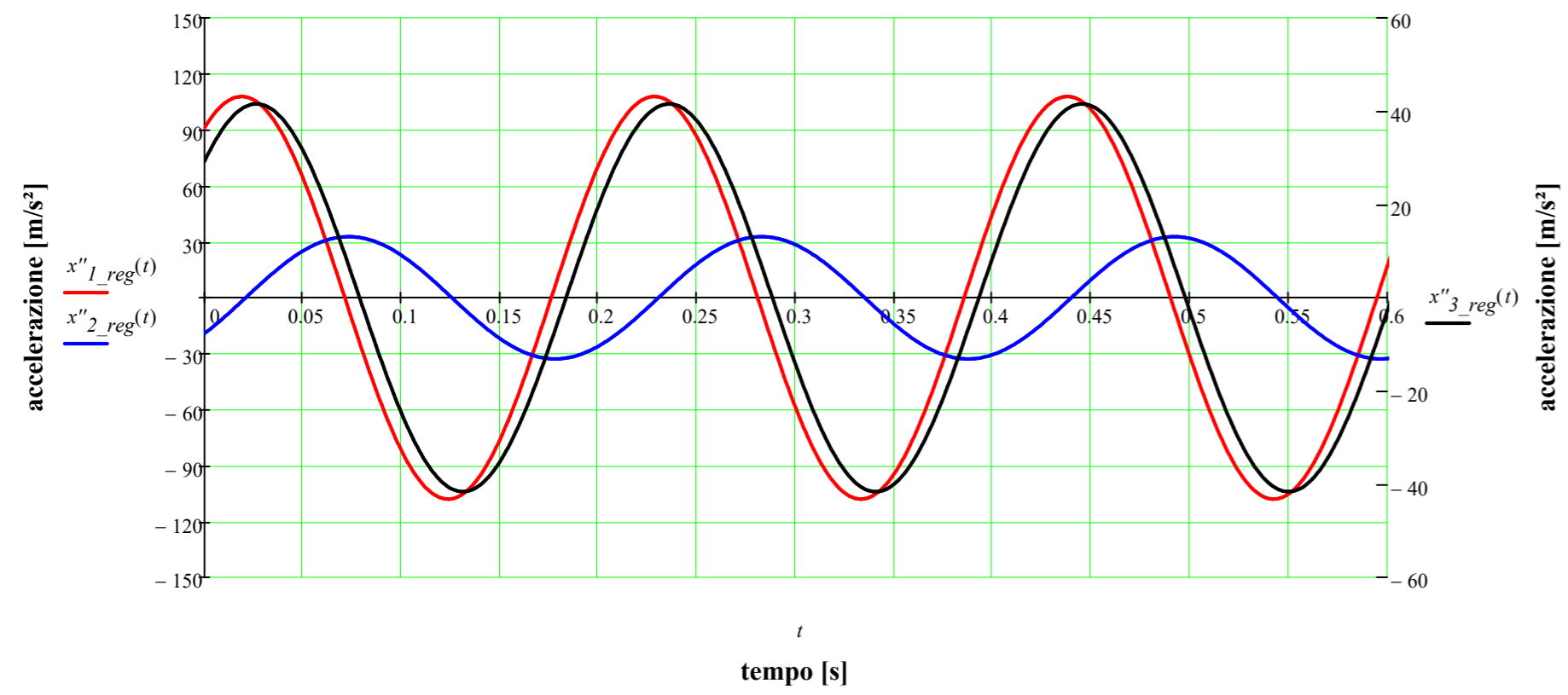
$$\varphi_3 := \text{arg}(\mathbf{X}(\Omega)_3) = -2.361$$

$$\begin{aligned}
 x_{1\_reg}(t) &:= X_1 \cdot \sin(\Omega \cdot t + \varphi_1) & x'_{1\_reg}(t) &:= \Omega \cdot X_1 \cdot \cos(\Omega \cdot t + \varphi_1) & x''_{1\_reg}(t) &:= -\Omega^2 \cdot X_1 \cdot \sin(\Omega \cdot t + \varphi_1) \\
 x_{2\_reg}(t) &:= X_2 \cdot \sin(\Omega \cdot t + \varphi_2) & x'_{2\_reg}(t) &:= \Omega \cdot X_2 \cdot \cos(\Omega \cdot t + \varphi_2) & x''_{2\_reg}(t) &:= -\Omega^2 \cdot X_2 \cdot \sin(\Omega \cdot t + \varphi_2) \\
 x_{3\_reg}(t) &:= X_3 \cdot \sin(\Omega \cdot t + \varphi_3) & x'_{3\_reg}(t) &:= \Omega \cdot X_3 \cdot \cos(\Omega \cdot t + \varphi_3) & x''_{3\_reg}(t) &:= -\Omega^2 \cdot X_3 \cdot \sin(\Omega \cdot t + \varphi_3)
 \end{aligned}$$

$$\Omega = 30 \quad T := \frac{2 \cdot \pi}{\Omega} = 0.209 \quad N_{per} := 3 \quad T_{max} := N_{per} \cdot T = 0.628$$

$$t := 0, 0.001 \dots T_{max}$$





$$\Omega = 30$$

$$\omega_k = 0, 0.01 \dots 50$$

$$\mathbf{X}(\Omega) := \mathbf{Z}(\Omega)^{-1} \cdot \mathbf{F}$$

$$AMP_1(\Omega) := |\mathbf{X}(\Omega)_1|$$

$$AMP_2(\Omega) := |\mathbf{X}(\Omega)_2|$$

$$AMP_3(\Omega) := |\mathbf{X}(\Omega)_3|$$

$$\omega = \begin{pmatrix} 9.419 \\ 18.538 \\ 23.526 \end{pmatrix} \quad k := 3 \quad \omega_k = 23.526$$

$$FASE_1(\Omega) := \arg(\mathbf{X}(\Omega)_1)$$

$$FASE_2(\Omega) := \arg(\mathbf{X}(\Omega)_2)$$

$$FASE_3(\Omega) := \arg(\mathbf{X}(\Omega)_3)$$

