$T1 := 10$

$t1 := 0, \frac{T1}{1 \cdot 10^3} .. T1$

Mass of body 1 $m_1 := 1$

Mass of body 2 $m_2 := 2$

Damping Coefficient $c_1 := 5$

Damping Coefficient $c_2 := 10$

Spring Constant k1 $k_1 := 100$

Spring Constant k2 $k_2 := 200$

External Force $F_1 := m_1 \cdot 9.81$

$F_2 := m_2 \cdot 9.81$

Given

$$\frac{d}{du} y0(u) = y1(u)$$

$$y0(0) = 0$$

$$\frac{d}{du} y1(u) = -\frac{k_1}{m_1} \cdot y0(u) - \frac{c_1}{m_1} \cdot y1(u) + \frac{k_2}{m_1} \cdot (y2(u) - y0(u)) + \left(\frac{c_2}{m_1}\right) \cdot (y3(u) - y1(u)) + \frac{F_1}{m_1}$$

$$y1(0) = 0$$

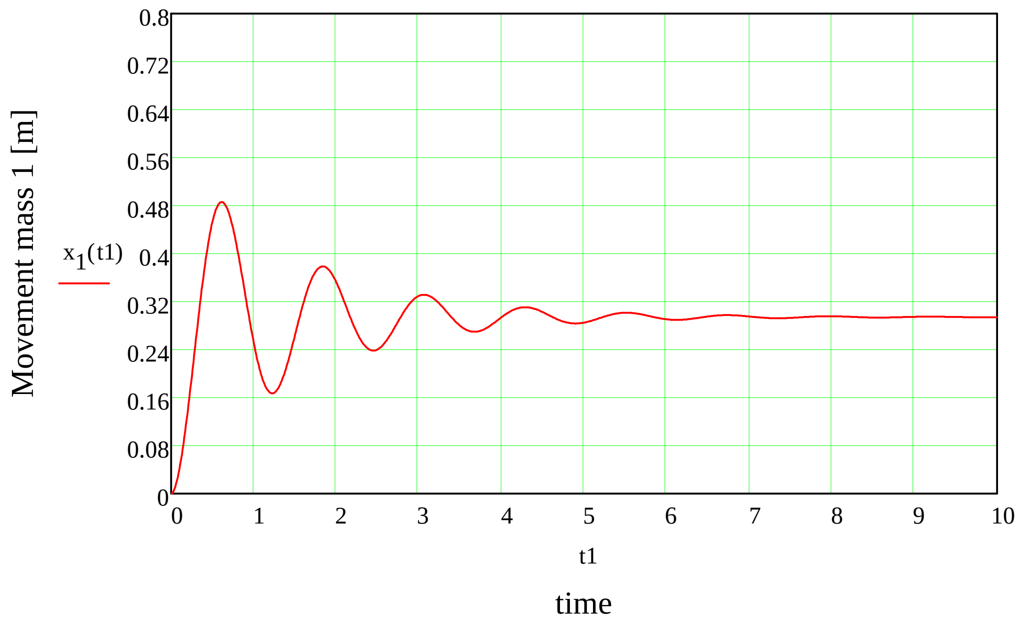
$$\frac{d}{du} y2(u) = y3(u)$$

$$y2(0) = 0$$

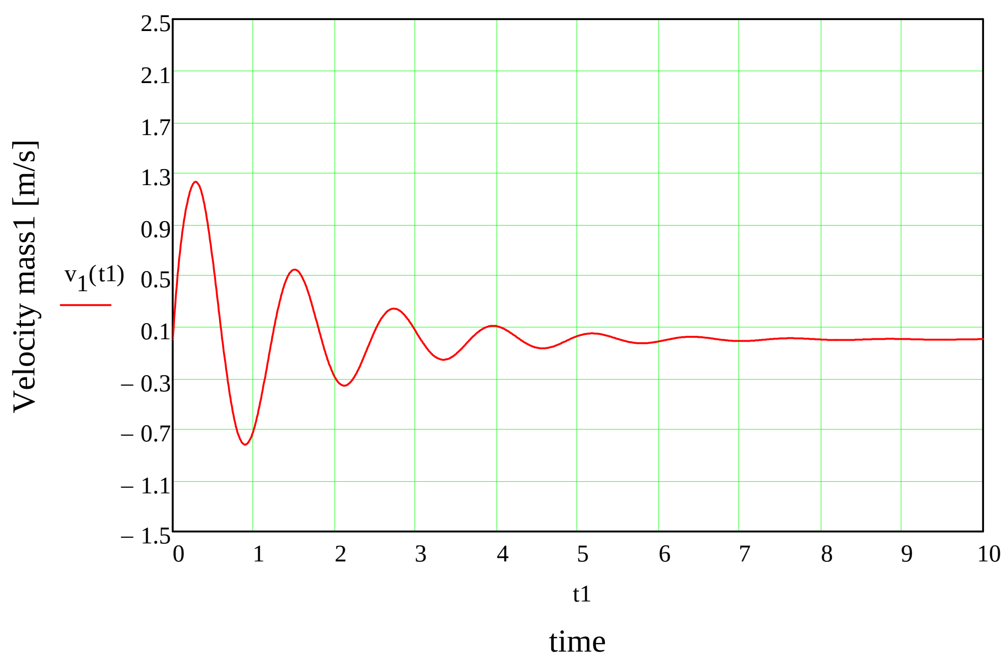
$$\frac{d}{du} y3(u) = -\frac{c_2}{m_2} \cdot (y3(u) - y1(u)) - \left(\frac{k_2}{m_2}\right) \cdot (y2(u) - y0(u)) + \frac{F_2}{m_2}$$

$$y3(0) = 0$$

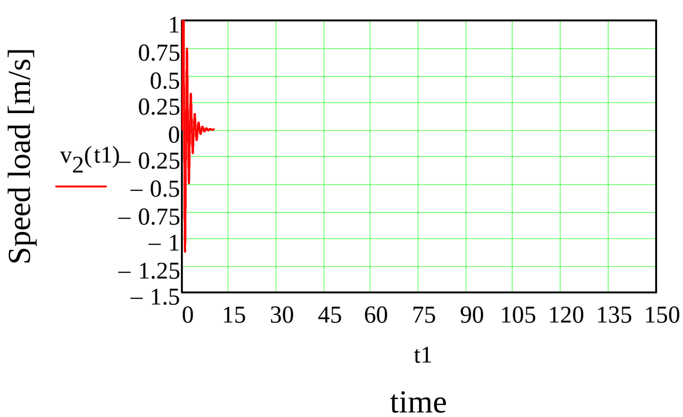
$$\begin{pmatrix} x_1 \\ v_1 \\ x_2 \\ v_2 \end{pmatrix} := \text{Odesolve}\left[\begin{pmatrix} y0 \\ y1 \\ y2 \\ y3 \end{pmatrix}, u, T1, 10000\right]$$



Movement mass 1 [m]
$x_1(t1)$
0.8
0.72
0.64
0.56
0.48
0.4
0.32
0.24
0.16
0.08
0
0 1 2 3 4 5 6 7 8 9 10
t1
time



Velocity mass1 [m/s]
$v_1(t1)$
2.5
2.1
1.7
1.3
0.9
0.5
0.1
− 0.3
− 0.7
− 1.1
− 1.5
0 1 2 3 4 5 6 7 8 9 10
t1
time

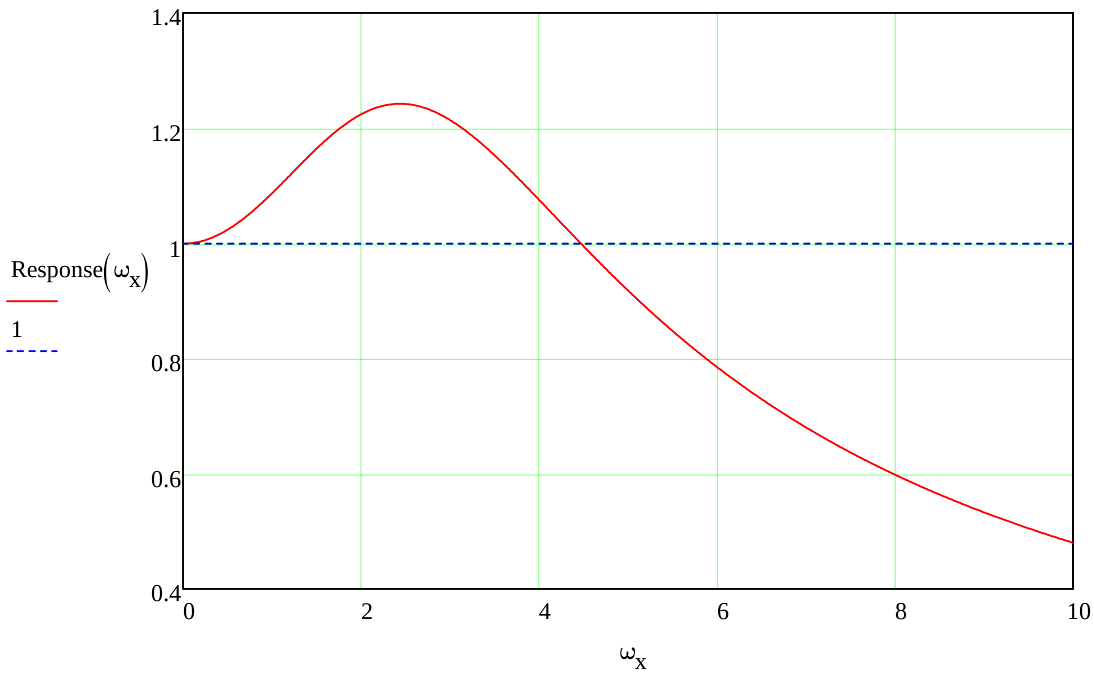

Speed load [m/s]
v2(t1)
1
0.75
0.5
0.25
0
− 0.25
− 0.5
− 0.75
− 1
− 1.25
− 1.5
0
15
30
45
60
75
90
105
120
135
150
t1
time

Mass module (incl. added mass)	$M_1 := 100000kg$	tons	
Drag damping on module	$c_{d1} := 500 \frac{kN \cdot s}{m}$	$\omega_1 := 1.047 \cdot \frac{1}{s}$	e
Compensator stiffness	$k_{c1} := 1000 \frac{kN}{m}$		
Compensator damping:	$c_{c1} := 20 \frac{kN \cdot s}{m}$		
Natural frequency	$\omega_n := \sqrt{\frac{k_{c1}}{M_1}}$	$\omega_n = 3.162 \frac{1}{s}$	
Periode natural frequency	$T_n := \frac{2\pi}{\omega_n}$	$T_n = 1.987 s$	
Ratio between and angular freqency	$r(\omega) := \frac{\omega_1}{\omega_n}$	$r(\omega) = ▮$	
Critical damping	$c_{crit} := 2 \cdot M_1 \cdot \omega_n$	$c_{crit} = 632.456 \cdot \frac{kN \cdot s}{m}$	
Damping ratio	$\beta := \frac{c_{c1} - c_{d1}}{c_{crit}}$	$\beta = -0.759$	

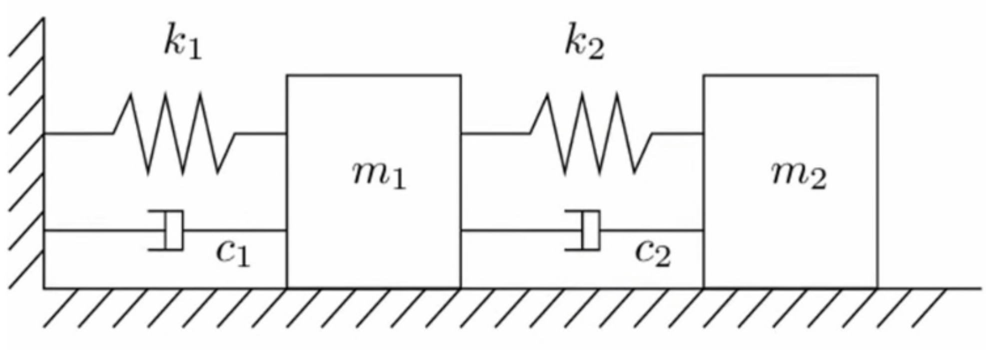
https://en.wikipedia.org/wiki/Damping_ratio

The system is under harmonic motion, and the response is defined as:

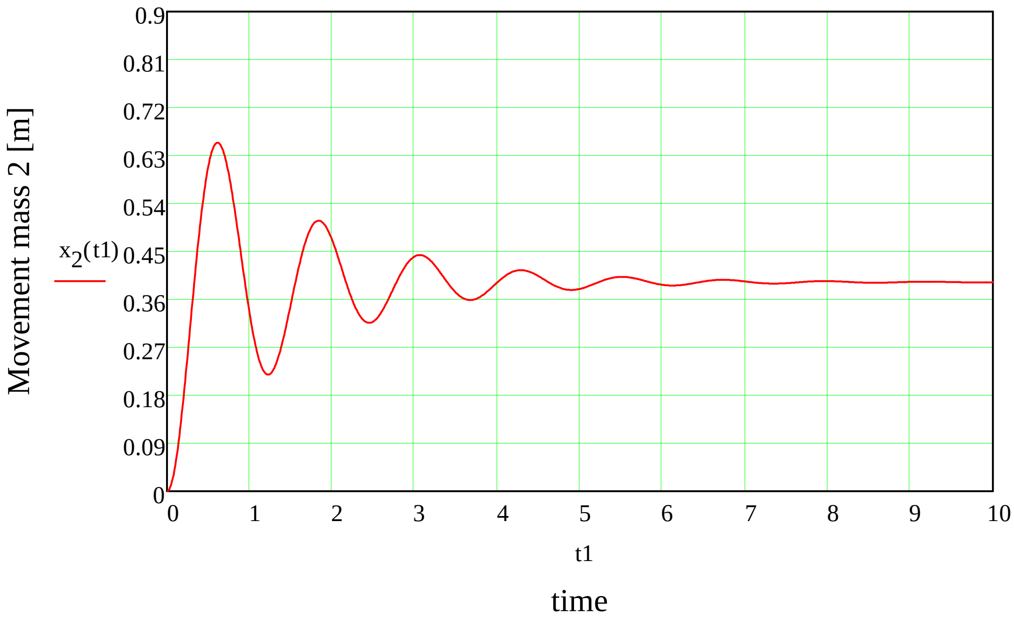
$$\text{Response}(\omega_x) := \sqrt{\frac{1 + \left(2\cdot\beta\cdot\frac{\omega_x}{\omega_n}\right)^2}{\left[1 - \left(\frac{\omega_x}{\omega_n}\right)^2\right]^2 + \left(2\cdot\beta\cdot\frac{\omega_x}{\omega_n}\right)^2}}$$

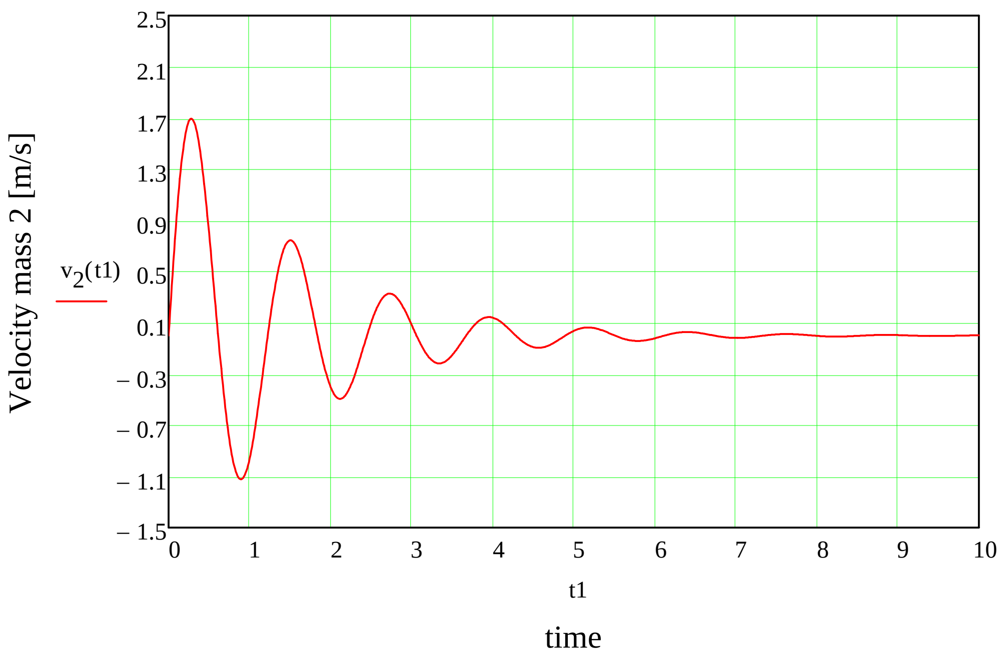


The figure shows the response of the compensator. The peak corresponds to undampened natural frequency for the system. Peak is high above 1 and system should never be used for these frequencies. Dotted lines shows where the response becomes 1 for frequencies below this point the compensator will not work.



k_1
k_2
m_1
m_2
c_1
c_2


Movement mass 2 [m]
$x_2(t1)$
0.9
0.81
0.72
0.63
0.54
0.45
0.36
0.27
0.18
0.09
0
0 1 2 3 4 5 6 7 8 9 10
t1
time


Velocity mass 2 [m/s]
$v_2(t1)$
2.5
2.1
1.7
1.3
0.9
0.5
0.1
− 0.3
− 0.7
− 1.1
− 1.5
0 1 2 3 4 5 6 7 8 9 10
t1
time