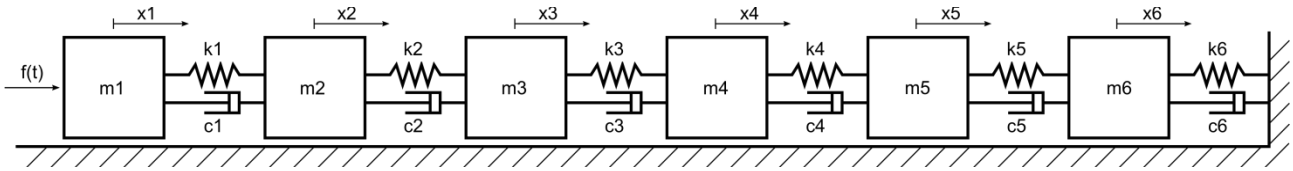
Schwingerkette mit sechs Freiheitsgraden



Die Schwingerkette hat 6 Freiheitsgrade und wird durch die Bewegungsgleichung

$$\mathbf{M}\ddot{x} + \mathbf{C}\dot{x} + \mathbf{K}x = \mathbf{F}(t)$$

mit

$$\mathbf{M} = \begin{bmatrix} m1 & 0 & 0 & 0 & 0 & 0 \\ 0 & m2 & 0 & 0 & 0 & 0 \\ 0 & 0 & m3 & 0 & 0 & 0 \\ 0 & 0 & 0 & m4 & 0 & 0 \\ 0 & 0 & 0 & 0 & m5 & 0 \\ 0 & 0 & 0 & 0 & 0 & m6 \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} c1 & -c1 & 0 & 0 & 0 & 0 \\ -c1 & c1+c2 & -c2 & 0 & 0 & 0 \\ 0 & -c2 & c2+c3 & -c3 & 0 & 0 \\ 0 & 0 & -c3 & c3+c4 & -c4 & 0 \\ 0 & 0 & 0 & -c4 & c4+c5 & -c5 \\ 0 & 0 & 0 & 0 & -c5 & c5+c6 \end{bmatrix},$$

$$\mathbf{K} = \begin{bmatrix} k1 & -k1 & 0 & 0 & 0 & 0 \\ -k1 & k1+k2 & -k2 & 0 & 0 & 0 \\ 0 & -k2 & k2+k3 & -k3 & 0 & 0 \\ 0 & 0 & -k3 & k3+k4 & -k4 & 0 \\ 0 & 0 & 0 & -k4 & k4+k5 & -k5 \\ 0 & 0 & 0 & 0 & -k5 & k5+k6 \end{bmatrix}, \quad x = \begin{bmatrix} x1 \\ x2 \\ x3 \\ x4 \\ x5 \\ x6 \end{bmatrix}.$$

beschrieben. Es werden die folgenden Werte angenommen:

$$m\mathrm{i} = 1\ \mathrm{kg}, \mathrm{i} = 1, \dots, 6$$
$$k\mathrm{i} = 10\ \mathrm{N/m}, \mathrm{i} = 1, \dots, 6$$
$$c\mathrm{i} = 0\ \mathrm{Ns/m}, \mathrm{i} = 1, \dots, 6.$$

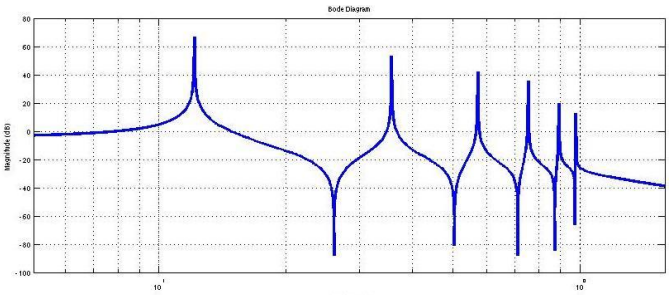
Es folgen die Eigenwerte und Eigenvektoren des ungedämpften Systems

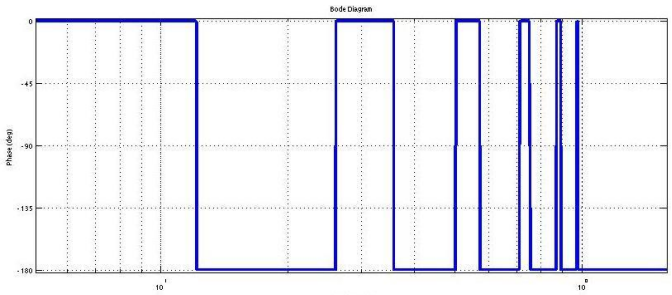
$$\Omega^2 = \begin{bmatrix} 0.5812 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5.0298 & 0 & 0 & 0 & 0 \\ 0 & 0 & 12.9079 & 0 & 0 & 0 \\ 0 & 0 & 0 & 22.4107 & 0 & 0 \\ 0 & 0 & 0 & 0 & 31.3613 & 0 \\ 0 & 0 & 0 & 0 & 0 & 37.7091 \end{bmatrix}$$

$$\lambda_{i_{1,2}} = \begin{bmatrix} 0 \pm 0.7623i \\ 0 \pm 2.2427i \\ 0 \pm 3.5928i \\ 0 \pm 4.7340i \\ 0 \pm 5.6001i \\ 0 \pm 6.1408i \end{bmatrix}$$

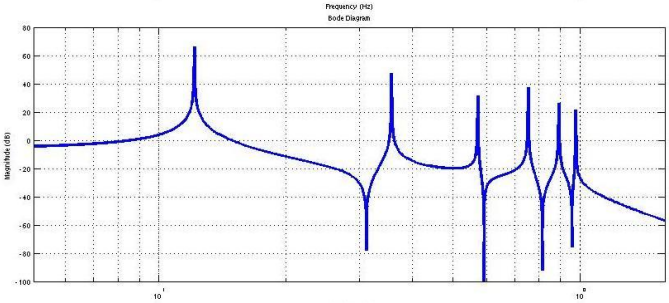
$$\phi = \begin{bmatrix} +0.5507 & +0.5187 & -0.4565 & -0.3678 & +0.2578 & -0.1327 \\ +0.5187 & +0.2578 & +0.1327 & +0.4565 & -0.5507 & +0.3678 \\ +0.4565 & -0.1327 & +0.5507 & +0.2578 & +0.3678 & -0.5187 \\ +0.3678 & -0.4565 & +0.2578 & -0.5187 & +0.1327 & +0.5507 \\ +0.2578 & -0.5507 & -0.3678 & -0.1327 & -0.5187 & -0.4565 \\ +0.1327 & -0.3678 & -0.5187 & +0.5507 & +0.4565 & +0.2578 \end{bmatrix}.$$

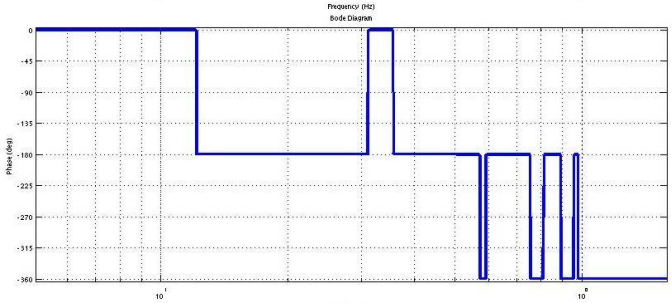
α_{11}



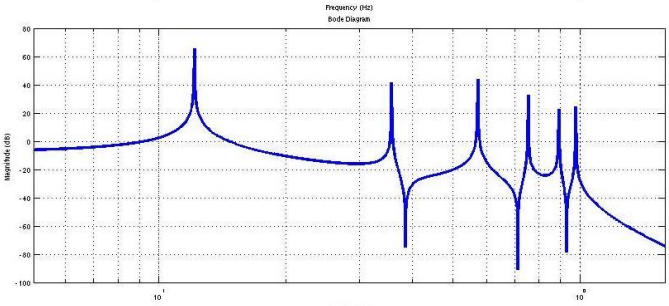


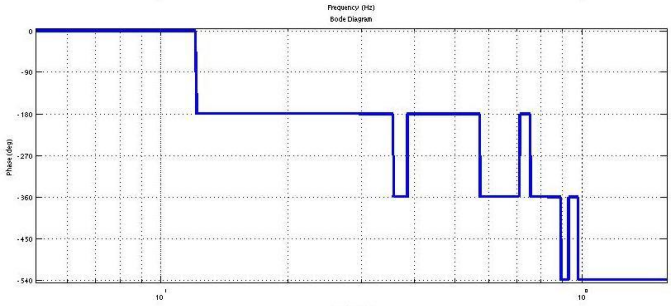
α_{21}



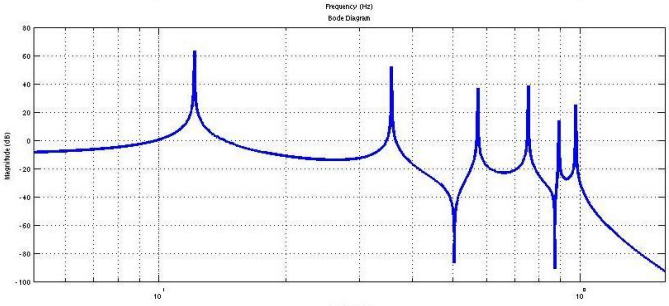


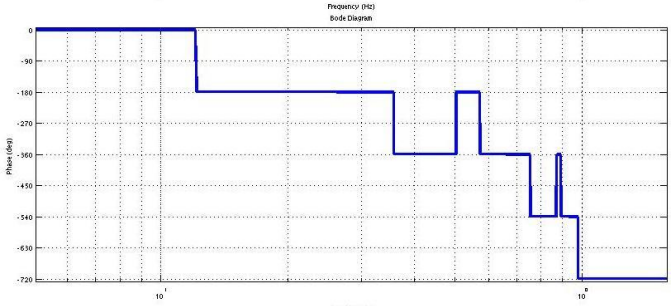
α_{31}



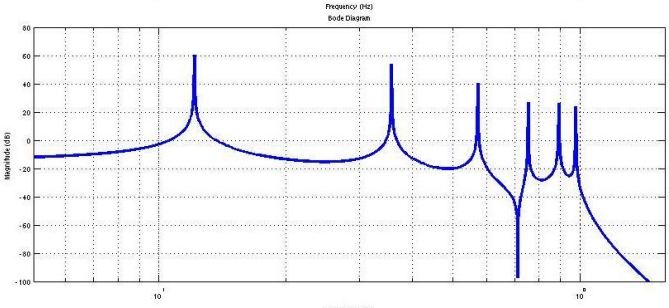


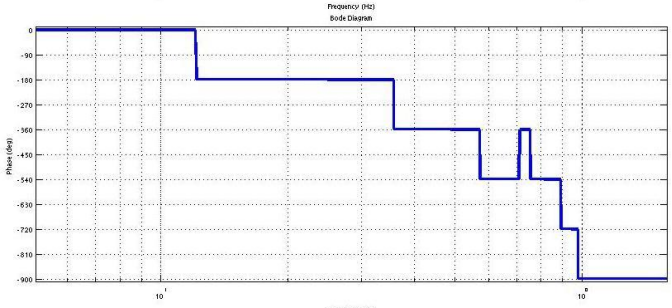
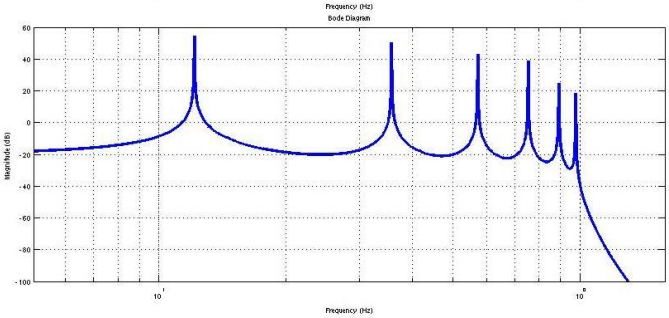
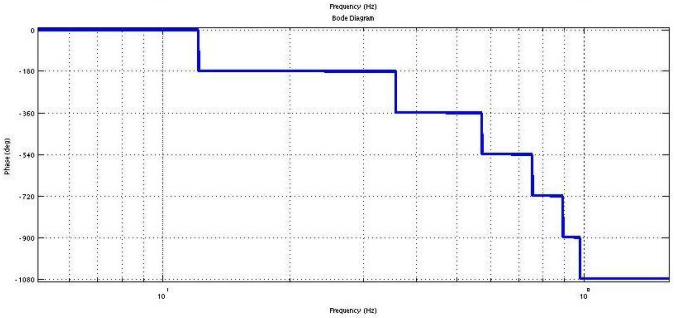
α_{41}





α_{51}





α_{61}