7. Modalanalyse, Modellbildung 2

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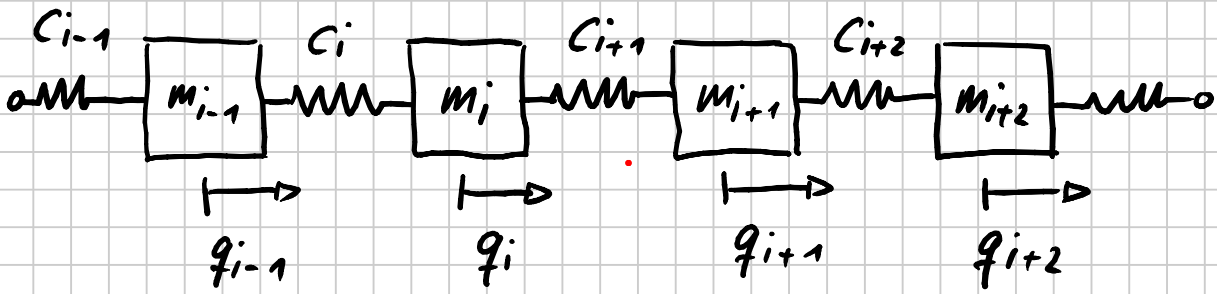
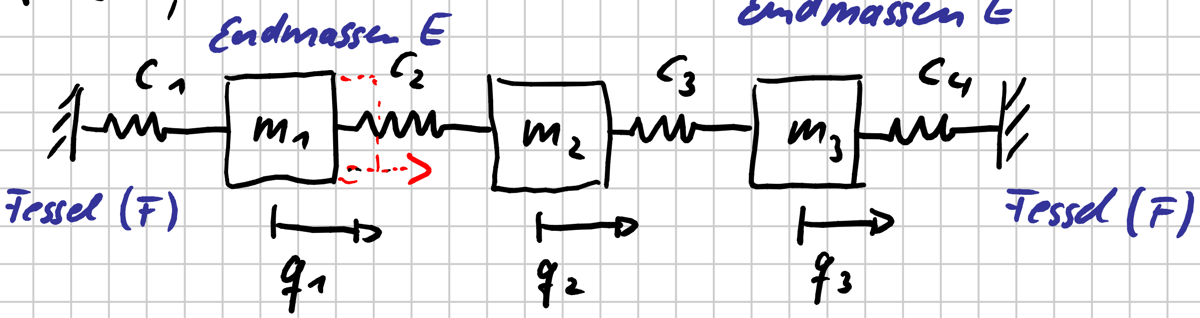
Bsp. 3 elastische Ketten, lineare Schwingerketten $f = n$, $n > 1$



Dgl.:

$$m_i \ddot{q}_i = -c_i (q_i - q_{i-1}) + c_{i+1} (q_{i+1} - q_i)$$

Bsp.: $f = 3$; $i = 1 \dots 3$



$i = 1$

$$m_1 \ddot{q}_1 = -c_1 (q_1 - 0) + c_2 (q_2 - q_1)$$

$$m_1 \ddot{q}_1 + (c_1 + c_2) q_1 - c_2 q_2 = 0 \qquad (1)$$

$i = 2$

$$m_2 \ddot{q}_2 = -c_2 (q_2 - q_1) + c_3 (q_3 - q_2)$$

$$m_2 \ddot{q}_2 + (c_2 + c_3) q_2 - c_2 q_1 - c_3 q_3 = 0 \qquad (2)$$

$i = 3$

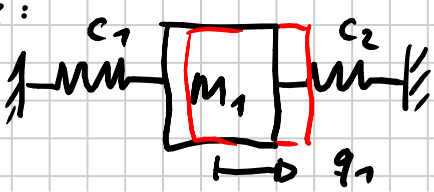
$$m_3 \ddot{q}_3 = -c_3 (q_3 - q_2) + c_4 (0 - q_3)$$

$$m_3 \ddot{q}_3 + (c_3 + c_4) q_3 - c_3 q_2 = 0 \qquad (3)$$

$$\begin{bmatrix} m_1 & 0 & 0 \\ 0 & m_2 & 0 \\ 0 & 0 & m_3 \end{bmatrix} \cdot \begin{bmatrix} \ddot{q}_1 \\ \ddot{q}_2 \\ \ddot{q}_3 \end{bmatrix} + \begin{bmatrix} c_1 + c_2 & -c_2 & 0 \\ -c_2 & c_2 + c_3 & -c_3 \\ 0 & -c_3 & c_3 + c_4 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_2 \end{bmatrix} = \bar{0}$$

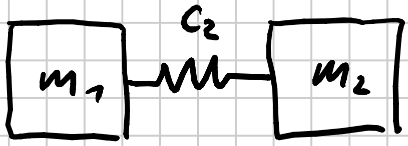
$$M \cdot \ddot{\bar{q}} + C \cdot \bar{q} = \bar{0}$$

Hauptdiagonale:



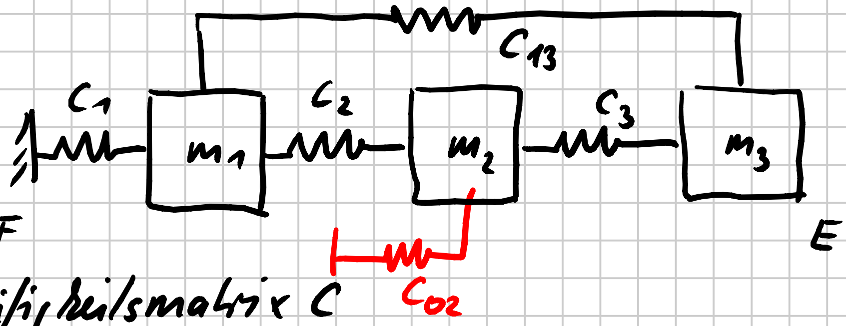
$c_1 + c_2$

Kopplung



$-c_2$

Bsp. $f=3$



Steifigkeitsmatrix C

$$C = \begin{bmatrix} c_1+c_2 & -c_2 & c_{13} \\ -c_2 & c_2+c_3+c_{02} & -c_3 \\ -c_{13} & -c_3 & c_3 \end{bmatrix}$$

$$\boxed{M\ddot{\bar{q}} + K\dot{\bar{q}} + C\bar{q} = \bar{f}_e} \quad f>1 \qquad \bar{f}_e = \begin{bmatrix} F_1(t) \\ F_2(t) \\ \vdots \\ F_n(t) \end{bmatrix}$$

$$\boxed{m\ddot{q} + k\dot{q} + cq = F(t) \quad f=1}$$