SISTEM PETIH UTEŽI V KRIŽU
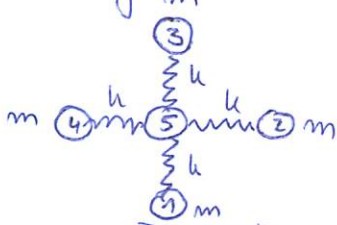
Imamo sistem petih utežj z enakimi masami m, ki so povezane z vzmetmi s koeficientom k v križ. Utež 3 izmaknemo v z smeri, tako da celotni sistem zaniha ni hajni mačini? Kakšne so lastne frekvence in lastni ni hajni mačini?

NAMIGI

- Kinetična energija: $T = \ldots = \frac{1}{2}\underline{\dot{z}}^T \underline{\underline{T}}\, \underline{\dot{z}}$; $\underline{\underline{T}} = m\,\underline{\underline{1}}$ ← identiteta

- Potencialna: $V = \frac{1}{2}\underline{z}^T \underline{\underline{V}}\, \underline{z}$; $\underline{\underline{V}} = k\begin{pmatrix} 1 & 0 & 0 & 0 & -1 \\ 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 1 & -1 \\ -1 & -1 & -1 & -1 & +4 \end{pmatrix}$

- Iz gibalne enačbe $\underline{\underline{V}}\,\underline{a} = \omega^2 \underline{\underline{T}}\,\underline{a}$ izračunaj ω^2! Namesto rešavanja 5×5 sistema, uganemo lastne nihajne mačine $\underline{a}_i$ in iz njih izračunamo ω_k: $\underline{a}_i^T \underline{a}_k = \delta_{ik}$

1) Tog premik: $\underline{a}_1^T = (1\,1\,1\,1\,1)$ uganemo

   Frekvenca: $\underline{\underline{V}}\,\underline{a}_1 = k\begin{pmatrix}0\\0\\0\\0\\0\end{pmatrix} = \omega_1^2 \underline{\underline{T}}\,\underline{a}_1 = \omega_1^2 m \underline{a}_1 \Rightarrow \omega_1^2 = 0$

2) 1,3 gor ; 2,4 dol: $\underline{a}_2^T = (1, -1\ 1\ -1\ 0) \Rightarrow \omega_2^2 = \omega_0^2$

3) 1,2 gor ; 3,4 dol : $\underline{a}_3^T = (1\,1\,-1\,-1\,0) \Rightarrow \omega_3^2 = \omega_0^2$

4) 1,4 gor ; 2,3 dol : $\underline{a}_4^T = (1\,-1\,-1\,1\,0) \Rightarrow \omega_4^2 = \omega_0^2$

5) 1,2,3,4 gor, 5 dol → za koliko?

   $\underline{a}_5^T = (1\,1\,1\,1\,d)$; $\underline{\underline{V}}\,\underline{a}_5 = \ldots = k\begin{pmatrix}1-d\\1-d\\1-d\\1-d\\-4+4d\end{pmatrix} = m\omega_5^2\begin{pmatrix}1\\1\\1\\1\\d\end{pmatrix}$ ⊛

$\Rightarrow \ldots c = \frac{1}{5}, d = -4$

im $\omega_5^2 = 5\frac{k}{m} = 5\omega_0^2$

$(1-d)c = 1$

$\Rightarrow \begin{pmatrix}1-d\\1-d\\1-d\\-4+4d\end{pmatrix}\cdot c = \begin{pmatrix}1\\1\\1\\d\end{pmatrix}$ (konst)