Matrices and Vectors of equation (7)

Mass-matrix

$$\mathbf{M}(\mathbf{q}_t) = \begin{bmatrix} m_P + m_R & 0 & -m_R l_{Rs}\sin(\gamma_R) & 0 \\ 0 & m_H + m_A & 0 & m_A l_{As}\sin(\gamma_A - \gamma_{A,off}) \\ -m_R l_{Rs}\sin(\gamma_R) & 0 & m_R l_{Rs}^2 + I_{Rzz} & 0 \\ 0 & m_A l_{As}\sin(\gamma_A - \gamma_{A,off}) & 0 & m_A l_{As}^2 + I_{Azz} \end{bmatrix}$$

Vector of generalized gyroscopic and centrifugal forces

$$\mathbf{k}(\mathbf{q}_t, \dot{\mathbf{q}}_t) = \begin{bmatrix} -m_R l_R \cos(\gamma_{Rs})\dot{\gamma}_R^2 \\ m_A l_{As}\cos(\gamma_A - \gamma_{A,off})\dot{\gamma}_A^2 \\ 0 \\ 0 \end{bmatrix}$$

Boolean matrix

$$\mathbf{H} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Generalized constraint forces

$$\mathbf{Q}^r = \mathbf{G}^T \cdot \boldsymbol{\lambda} = \begin{bmatrix} 1 & 0 \\ -1 & 0 \\ -l_R\sin(\gamma_R) & l_R\cos(\gamma_R) \\ -l_A\sin(\gamma_A) & -l_A\cos(\gamma_A) \end{bmatrix} \cdot \boldsymbol{\lambda}$$

Generalized applied forces

$$\mathbf{Q}^a = \mathbf{0}$$

Parameters (not defined in the paper)

l_{Rs}	distance between center of mass of the rod and the joint connecting rod and support
l_{As}	distance between center of mass of the cantilever and the joint connecting cantilever and support
m_i	masses of the four rigid bodies P, H, R, A
I_{Rzz}	inertia of the rod
I_{Azz}	inertia of the cantilever
$\gamma_{A,off}$	angle between the axis *center of mass - joint connecting cantiveler and support* and the axis *joint conneting rod and cantilever - joint connecting cantilever and support*