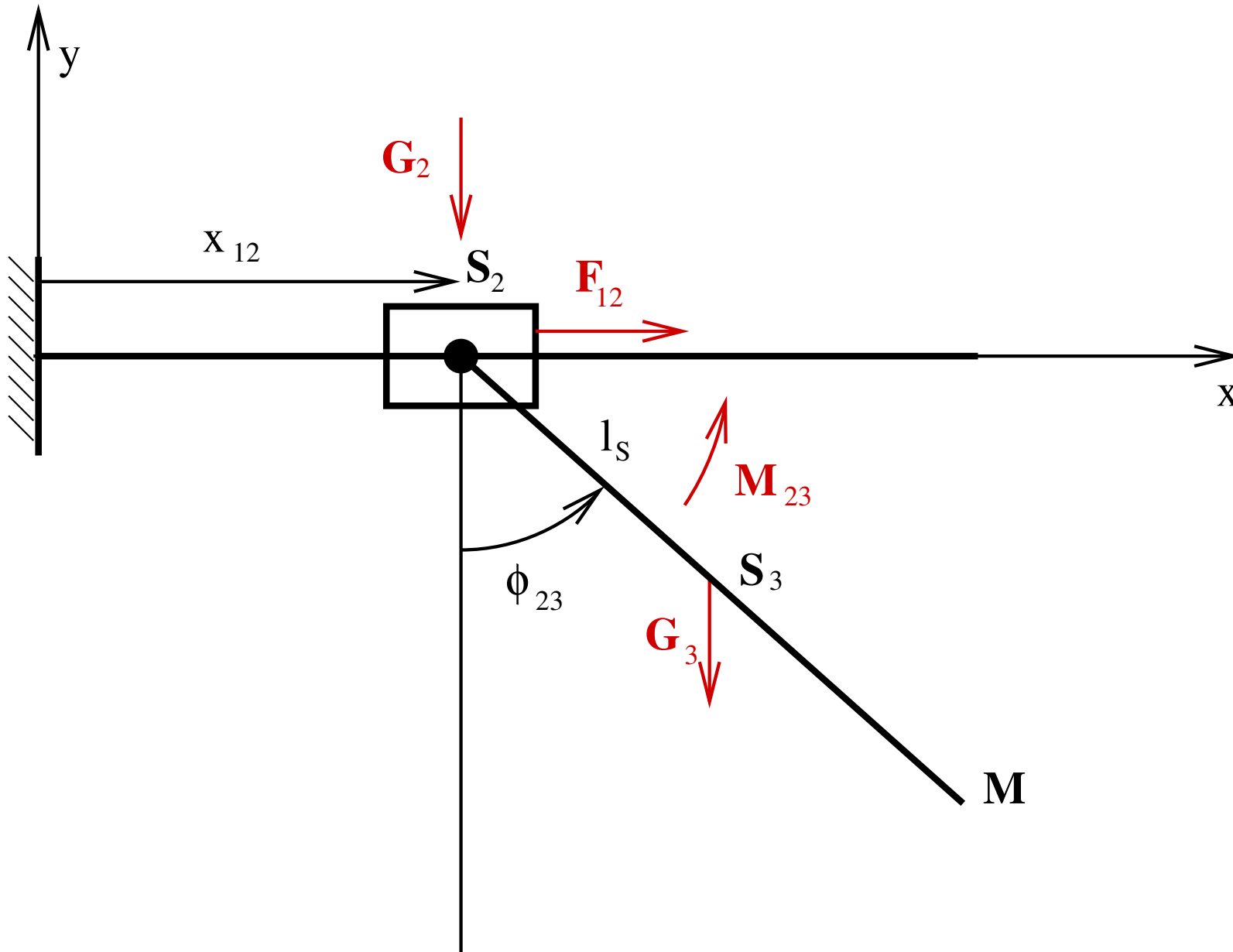


Torque Control Example



$$S_2 = \begin{pmatrix} x_{12} \\ 0 \end{pmatrix}$$

$$l_s = |S_2 S_3|$$

$$l_3 = |S_2 M|$$

Known:

$$(l_s, l_3, m_2, m_3, I_{3S3}, b, \mu)^T$$

Required motion:

$$(x_{1M}, y_{1M})^T$$

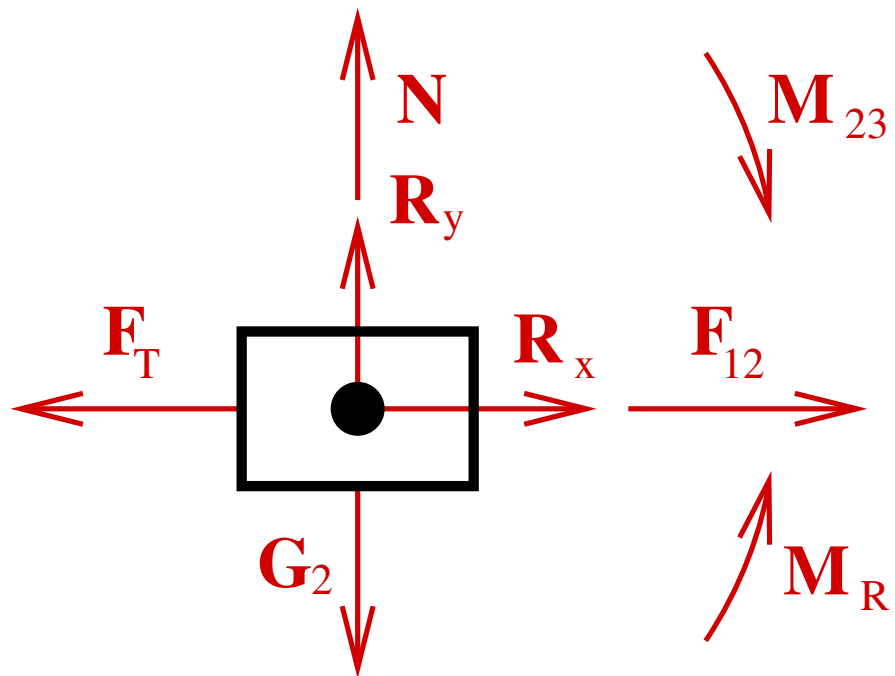
Input variables:

$$(F_{12}, M_{23})^T$$

Independent variables:

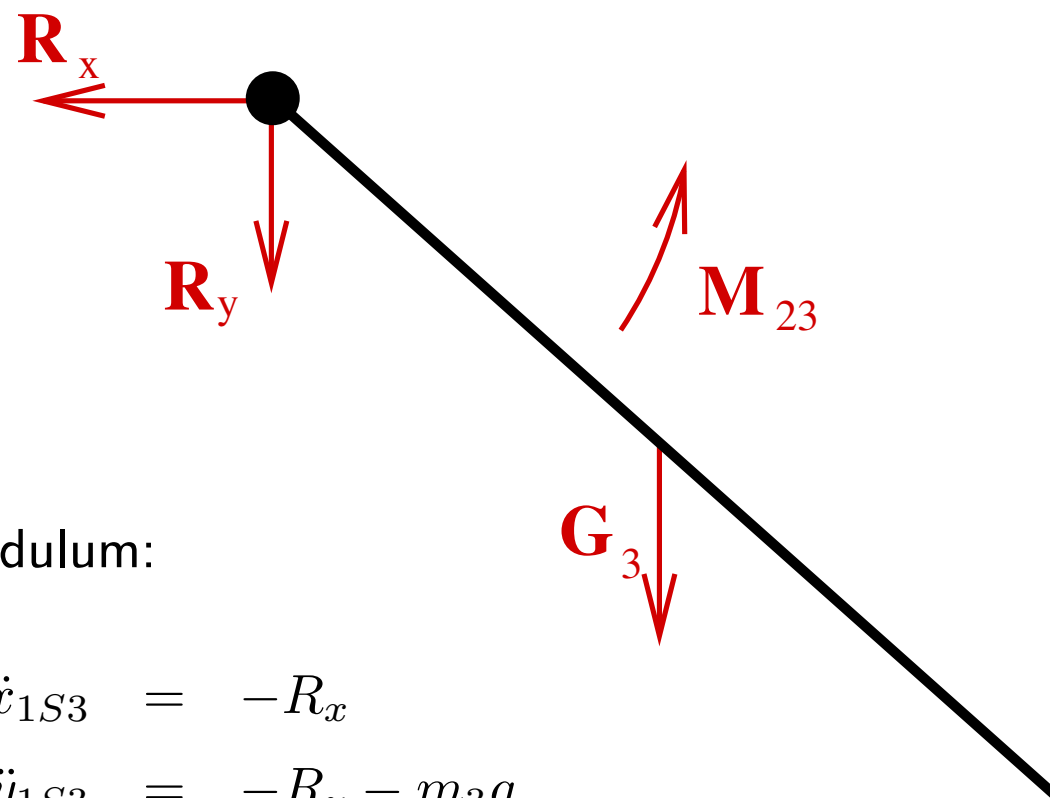
$$(x_{12}, \phi_{23})^T$$

Uvolňování



Slider:

$$\begin{aligned}
 m_2 \ddot{x}_{12} &= F_{12} + R_x - F_T \\
 0 &= N + R_y - m_2 g \\
 0 &= M_{23} - M_r \\
 F_T &= b \dot{x}_{12} + \mu \operatorname{sgn}(\dot{x}_{12}) |N|
 \end{aligned}$$



Pendulum:

$$\begin{aligned}
 m_3 \ddot{x}_{1S3} &= -R_x \\
 m_3 \ddot{y}_{1S3} &= -R_y - m_3 g \\
 I_{3S3} \ddot{\phi}_{23} &= R_y l_S \sin \phi_{23} + R_x l_S \cos \phi_{23} + M_{23}
 \end{aligned}$$

Dynamics equations:

$$\begin{aligned}
 (m_2 + m_3)\ddot{x}_{12} + b\dot{x}_{12} + \mu \operatorname{sgn}(\dot{x}_{12}) |m_2g + m_3g + m_3l_S\dot{\phi}_{23}^2 \cos \phi_{23} + m_3l_S\ddot{\phi}_{23} \sin \phi_{23}| &= \\
 &= F_{12} - m_3l_S\ddot{\phi}_{23} \cos \phi_{23} + m_3l_S\dot{\phi}_{23}^2 \sin \phi_{23} \\
 &= M_{23} - m_3gl_S \sin \phi_{23} - m_3l_S^2\ddot{\phi}_{23} - m_3l_S\ddot{x}_{12} \cos \phi_{23}
 \end{aligned}$$

Nonlinear transformation of input, the plus/minus sign is applied according $\operatorname{sgn}(\dot{x}_{12})$ and $\operatorname{sgn}(\vec{N})$

$$\begin{aligned}
 \mathbf{M} &= \begin{pmatrix} m_2 + m_3 & m_3l_S \cos \phi_{23} \pm m_3l_S \sin \phi_{23} \\ m_3l_S \cos \phi_{23} & I_{3S3} + m_3l_S^2 \end{pmatrix} \\
 \vec{N} &= \begin{pmatrix} b\dot{x}_{12} \pm \mu(m_2g + m_3g + m_3l_S\dot{\phi}_{23}^2 \cos \phi_{23}) - m_3l_S\dot{\phi}_{23}^2 \sin \phi_{23} \\ m_3gl_S \sin \phi_{23} \end{pmatrix}
 \end{aligned}$$

Structure of the Torque Control Controller

