Model Documentation of the Loading Bridge

1 Nomenclature

1.1 Nomenclature for Model Equations

x_m	way of the load
x_M	way of the wagon
φ	angle of deflection of the load in relation to the center of the wagon
m	mass of the load
M	mass of the wagon
l	rope length
g	acceleration due to gravitation
f	force that pushes the wagon

2 Model Equations

State Vector and Input Vector:

$$\underline{x} = (x_1\ x_2\ x_3\ x_4)^T = (x_M\ \varphi\ \dot{x}_M\ \dot{\varphi})^T$$
$$\underline{u} = f$$

System Equations:

$$\dot{x}_1 = x_3 \tag{1a}$$
$$\dot{x}_2 = x_4 \tag{1b}$$
$$\dot{x}_3 = g\frac{m}{M}x_2 + \frac{1}{M}u \tag{1c}$$
$$\dot{x}_4 = -\frac{g}{l}(1 + \frac{m}{M})x_2 - \frac{1}{lM}u \tag{1d}$$

Parameters: $m\ M\ l\ g$
Outputs: $x_m\ x_M$

2.1 Assumptions

1. The friction is neglected
2. Mass of the load is a pointmass
3. Mass of the wagon is a pointmass

2.2 Exemplary parameter values

Parameter Name	Symbol	Value	Unit
mass of the last	m	3000	kg
mass of the wagon	M	8000	kg
rope length	l	2	m
acceleration due to gravitation	g	9.81	$\frac{m}{s^2}$

3 Derivation and Explanation

Not available

References