Model Documentation of the:

Kapitza's Pendulum

1 Nomenclature

1.1 Nomenclature for Model Equations

γ	Dampening factor
l	length of the pendulum
g	acceleration due to gravity
φ	angle of deflection from the equilibrium position
a	magnitude of the harmonic oscillation of the suspension point
ω	frequency of the harmonic oscillation of the suspension point

1.2 Nomenclature for Derivation

2 Model Equations

State Vector: $(x_1 \;\; x_2)^T = (\varphi \;\; \dot{\varphi})^T$

$$\frac{d}{dt}\varphi = \dot{\varphi} \tag{1a}$$

$$\frac{d}{dt}\dot{\varphi} = -2\gamma\dot{\varphi} - \left(\frac{g}{l} - \frac{a}{l}\omega^2\cos(\omega t)\right)\sin\varphi \tag{1b}$$

Inputs:
Parameters: $\omega,\ a,\ l,\ g,\ \gamma$
Outputs: φ

2.1 Assumptions

1. Mass of the pendulum is a pointmass

2.2 Exemplary parameter values

Parameter Name	Symbol	Value	Unit
Pendulum length	l	10	cm
acceleration due to gravitation	g	9.81	$\frac{m}{s^2}$
Amplitude of Oscillation	a	0.2 l	cm
Frequency of Oscillation	ω	$16\omega_0$	Hz
Dampening Factor	γ	$0.1\omega_0$	Hz

with $\omega_0 = \sqrt{\frac{g}{l}}$

3 Derivation and Explanation

References

[1] Butikov, E. I.: *Kapitza's Pendulum: A Physically Transparent Simple Treatment*, unpublished 2021