MBS Benchmark A05: Flyball Governor

Benchmark Objective

The NMS benchmark problem **A05** is an example of a stiff mechanical system.

Benchmark Description

The **A05** benchmark problem is also known as Flyball governor and was invented by J. Watt in the 18th century. In this stiff mechanical system, coupler rods are substituted by spring-damper elements. Gravity acts in the negative y direction and the system moves under its effect.
Tab. 1 reports system properties.

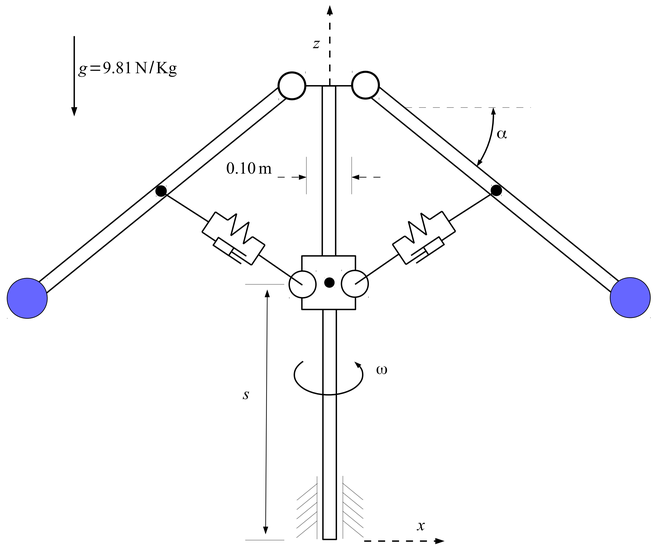

Figure 1: Flyball Governor sketch.

Axis, Rods	1.0 m × 0.001 m × 0.01 m
Base	0.01 m × 0.01 m × 0.1 m
Density ρ	3000 kg/m^3
Spring stiffness K	8×10^5 N/m
Spring damping C	4×10^4 Ns/m
Spring rest length	0.5 m
s	0.5 m
α	30°
$\dot{\omega}$	2π rad/s

Table 1: System Properties and Configuration

Results

The dynamic simulation of the **A05** benchmark was executed for 350 s. The starting position of the system in shown in Fig. 1 and numerical values are reported in Tab. 1. s values estimated with the OpenSim simulation are compared with the values provided as reference [1].
Fig. 2 shows the outputs of OpenSim-based simulation and the benchmark references [1] for a 3 s period.

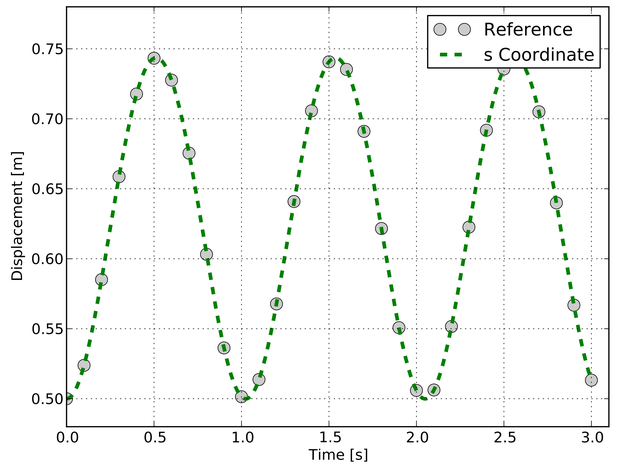

Figure 2: s values in OpenSim simulation (dashed lines) and MBS benchmark reference values (gray lines).

Download

- MBS Benchamark available at: `http://goo.gl/ySQ5me`
- OpenSim implementation available at: `http://goo.gl/R9tl3z`
- Videos of OpenSim simulation available at: `http://goo.gl/J3nOaY`

References

[1] M. González, D. Dopico, U. Lugrís, J. Cuadrado, *"A benchmarking system for MBS simulation software: Problem standardization and performance measurement,"* in Multibody System Dyn., vol. 6, no.2, 2006, pp. 179–190.

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