MBS Benchmark A02: N Four-Bar Mechanism

Benchmark Objective

The NMS benchmark problem **A02** is a common example of a mechanism which undergoes singular configuration [1].

Benchmark Description

N four-bar mechanism (Fig. 1) is a common example of a mechanism which undergoes singular configuration. The system has N four-bar windows composed of 2N+1 links. It is an extension of the two four-bar mechanism proposed in [2]. When the mechanism reaches the horizontal position, the number of the degrees of freedom instantaneously increase from 1 to N+1. Gravity is on the negative y direction.
Tab. 1 reports the system properties.

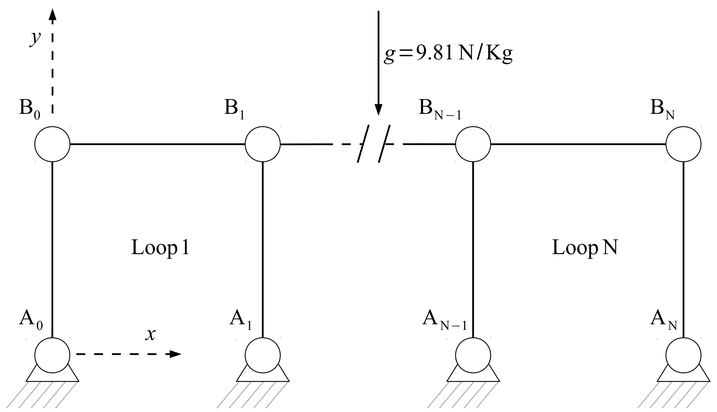

Figure 1: N four-bar mechanism sketch.

N	40
Link mass	1.0 kg
Link length	1.0 m
$\dot{B}_0 x(0)$	1.0 m/ s

Table 1: System Properties and Configuration

Results

The dynamic simulation of the **A02** benchmark was executed for 20 s. The starting position of the simulation is shown in Fig. 1 with an initial speed for the point B_0 in the positive x-direction of 1 m s^{-1}. The objective of the simulation is to measure the displacement of B_0, and compare the results with the reference solution [1].
The simulation with OpenSim perfectly matches the reference values. Fig. 2 shows a 10 s simulation.

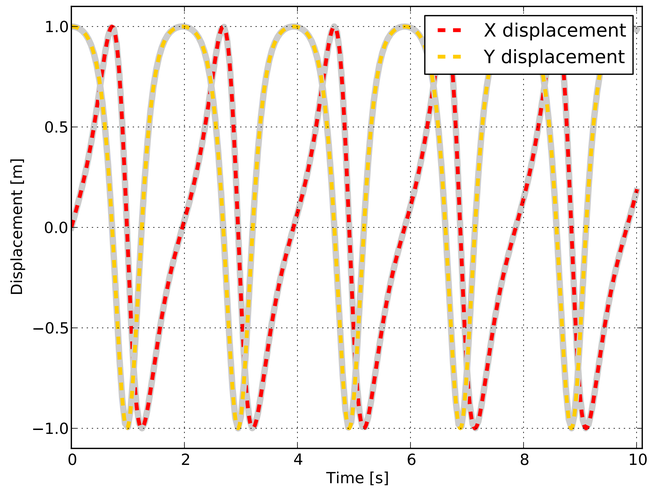

Figure 2: B_0 displacement in OpenSim simulation (dashed lines) and MBS benchmark reference values (gray lines).

Download

- MBS Benchmark available at: `http://goo.gl/ySQ5me`
- OpenSim implementation available at: `http://goo.gl/R9tl3z`
- Videos of OpenSim simulation available at: `http://goo.gl/q4G2FZ`

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.

[2] E. Bayo and A. Avello, *"Singularity-Free Augmented Lagrangian Algorithms for Constrained Multibody Dynamics,"* Nonlinear Dyn., vol. 5, no. 2, 1994, pp. 209–231.

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