EasyDyn problem: Rotating pendulum

O. Verlinden, G. Kouroussis

March 17, 2004

1 Description of the system

The considered system is represented in figure 1. As you can see it consists of a double pendulum with an additional degree of freedom: a general rotation of the mechanism. The bars A et B, defined by a length L and by a mass m, are attached together by a revolute joint of horizontal axis. The bar A is attached to the ground by two revolute joints: the first is a classical joint with horizontal axis, the second allows a constant rotation ω of vertical axis. From any configuration, the mechanism stabilizes as particular values of $\mathbf{q}_1$ et $\mathbf{q}_2$.

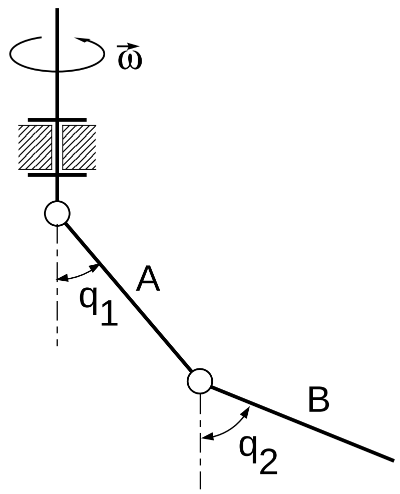

Figure 1: Schéma du double pendule en rotation

2 Requested results

It is asked to verify que q_1 et q_2 are determined[1] by

$$\frac{L\omega^2}{g}\cos q_1\left(8\sin q_1+3\sin q_2\right)-9\sin q_1=0 \tag{1}$$

[1] To stabilize the mechanism, the addition of a torsional damper between the two bodies is allowed.

et

$$\frac{L\omega^2}{g}\cos q_2\,(3\sin q_1 + 2\sin q_2) - 3\sin q_2 = 0 \tag{2}$$

Numerically, for $L\omega^2/g = 3$ ($L = 100\,mm$ et $\omega = 17,1522\,rad/s$), that comes down to verify $q_1 = 74,25°$ et $q_2 = 78,34°$

3 Typical results

Figures 2 to 4 give the expected evolutions of the configuration parameters and their time derivatives. We can see a stabilization on previous values.

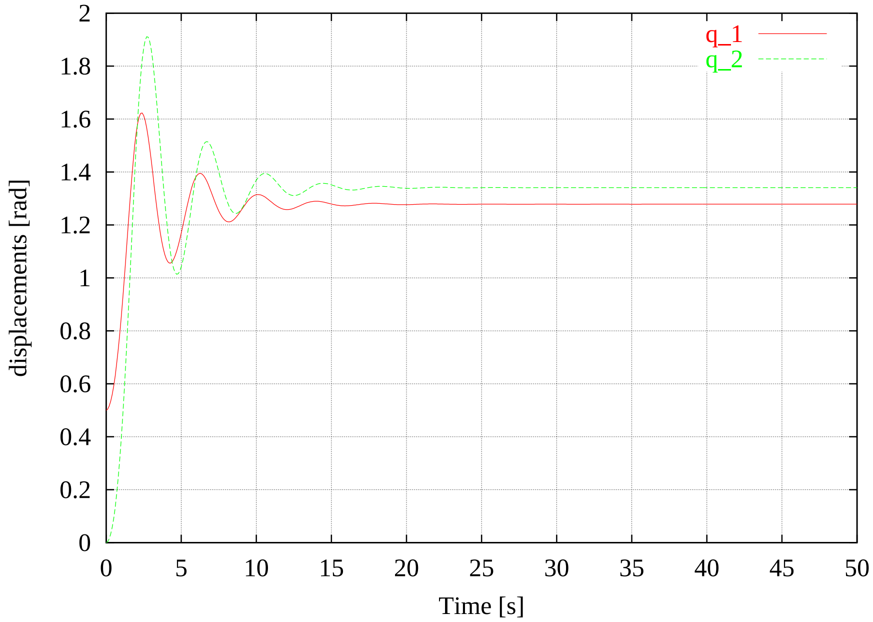

Figure 2: Evolution of configuration parameters

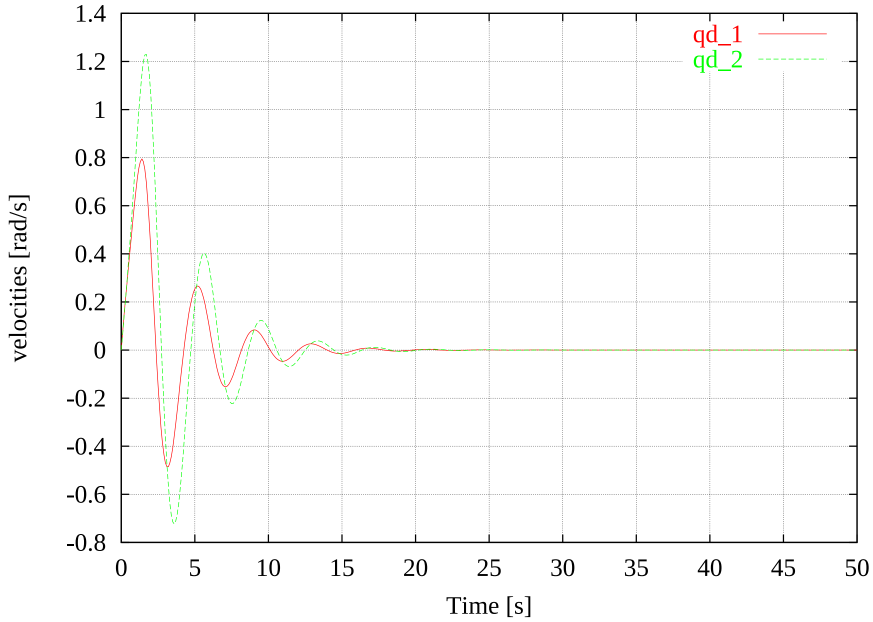

Figure 3: Evolution of first time derivatives of configuration parameters

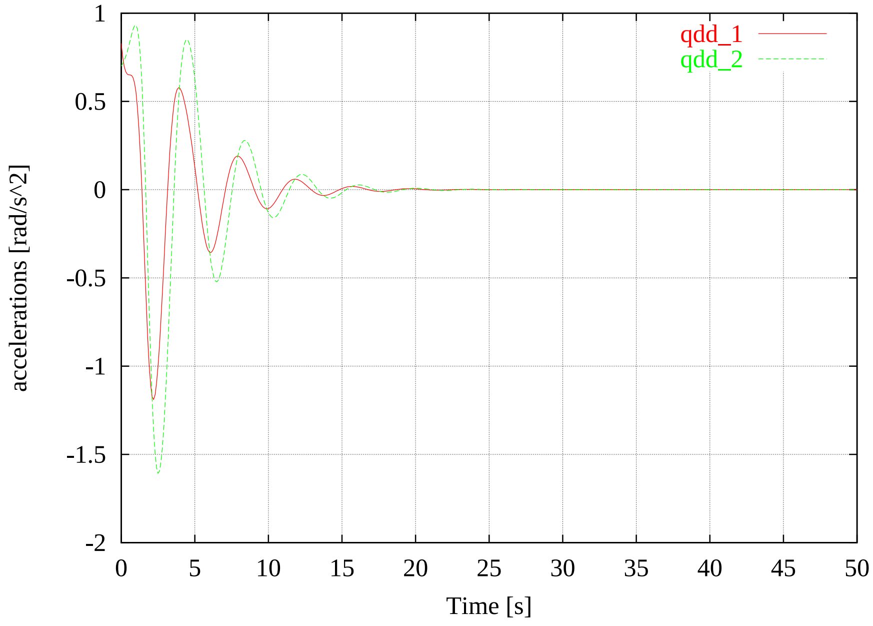

Figure 4: Evolution of second time derivatives of configuration parameters