Block sliding on a frictional table

Reference: Florian A. Potra, Mihai Anitescu, Bogdan Gavrea, Jeff Trinkle. A linearly implicit trapezoidal method for integrating stiff multibody dynamics with contact, joints, and friction. International Journal for Numerical Methods in Engineering, vol. 66, pp. 1079-1124, 2006.

Analysis: Explicit dynamics, frictional stick-slip transition.

Purpose: Examine the accuracy of an analysis involving persistent contact and stick-slip transition.

Summary: A block subjected to a sinusoidal force slips over a frictional surface. Position and velocity plots are compared against those available in the source paper.

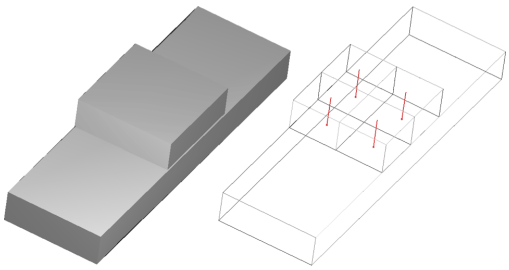

Figure 1: Block sliding on top of a frictional surface - initial configuration with four contact points.

The block has been discretised into four hexahedral elements, thus four contact points result from the element to element contact model implemented in *Solfec*. An equivalent three-dimensional model is used in *Solfec* as the reference [1] uses a two-dimensional set-up. The external force acting on the mass centre of the cube reads

$$\mathbf{f}(t) = [8\cos(t), 0, 0] \tag{1}$$

1 Input parameters

Block density (kg/m^3)	$\rho = 111.1(1)$
Block dimensions (m)	$a \times b \times h = 0.3 \times 0.3 \times 0.1$
Initial velocities (m/s)	all zero
Gravity acceleration (m/s^2)	$\mathbf{g} = [0, 0, -9.81]$
Velocity restitution	$\epsilon = 0$
Coulomb friction coefficient	$\mu = 0.8$

2 Results

Simulation over the time interval $[0, 10]$ was performed with the time step $h = 0.001$. As the reference [1] does not specify numerical values of the results, a visual comparison of the v_x velocity component and the x-coordinate histories of the mass centre is provided in Figures 2 and 3.

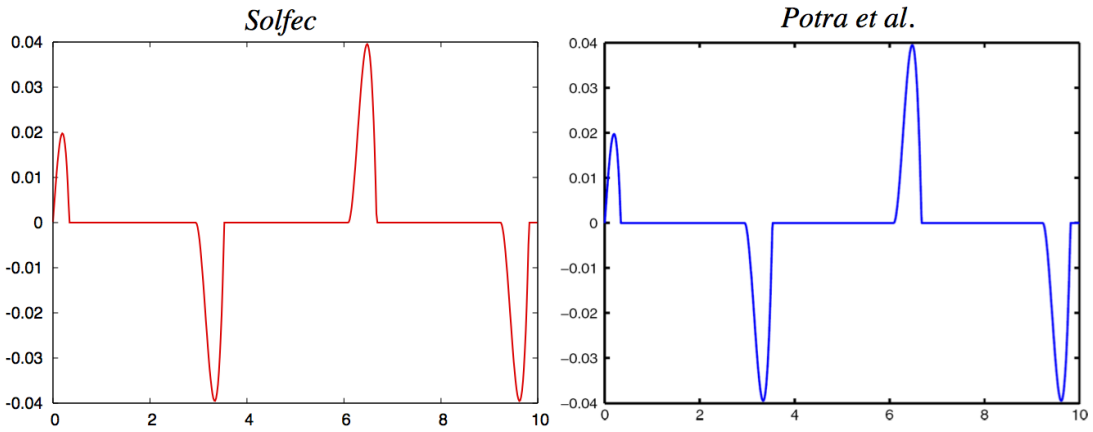

Figure 2: Comparison the v_x velocity component plots of the block mass centre.

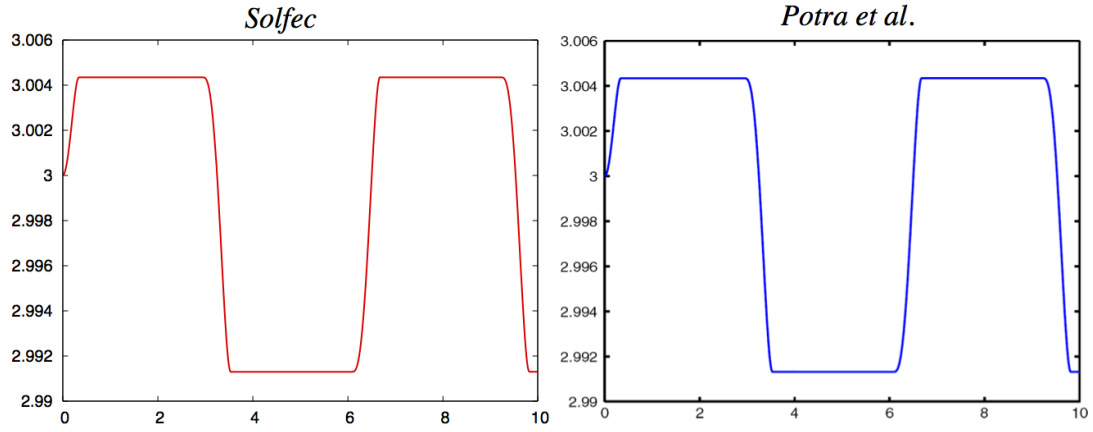

Figure 3: Comparison of the x-coordinate plots of the block mass centre.

References

[1] Florian A. Potra, Mihai Anitescu Bogdan Gavrea Jeff Trinkle, "A linearly implicit trapezoidal method for integrating stiff multibody dynamics with contact, joints, and friction", International Journal for Numerical Methods in Engineering (2006), 1079-1124.