

3D Rigid Body Simulation Tutorial



The stereo 3D rigid body simulation realizes free and non-free rigid body motion. The latter implicates several external forces (moments of forces) and two kinds of friction (external and internal). Also, the simulation presents a number of constructions and visualizations concerning the rigid body motion.

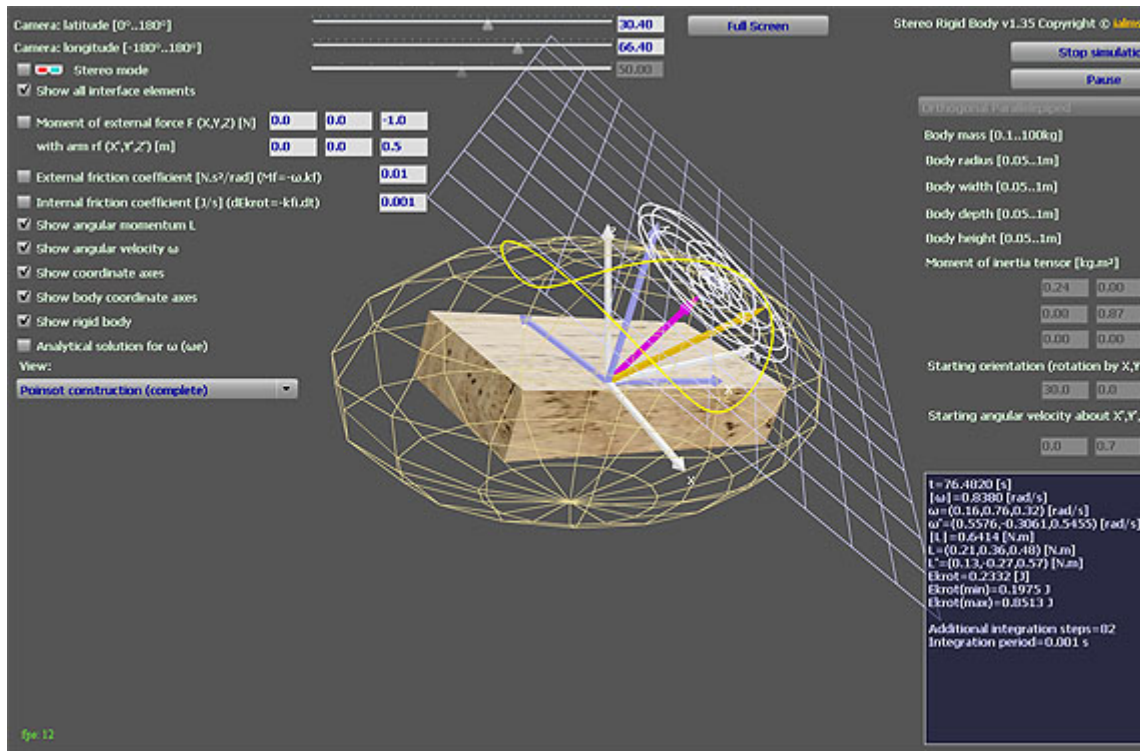


Figure 1. 3D rigid body simulation.

The 'Start simulation' button is used to begin the simulation process. The 'Pause' button pauses the simulation, but certain capabilities remain available in 'Pause' mode such as camera controls, and vectors and elements switching on and off. The rigid body is presented using 3D-polygon graphics with textures, light shades and anti-aliasing in order to increase the view quality and the level of perception. All vectors are shown in 3D-view as arrows painted in diverse colours. The rigid body center of mass is the origin of the space reference frame. Its vector axes can be observed by checking the 'Show coordinate axes' checkbox (shown with white coloured arrows). To visualize the body frame axes the student should check the 'Show body coordinate axes' checkbox (shown in blue-cyan colour). The student may also observe the angular velocity vector (shown with orange colour) and the angular momentum vector (shown in magenta colour) by checking the corresponding checkboxes. In the data panel (found in the lower-right), values of the currently drawn vectors components are printed along with other scalars describing the simulated process such as the kinetic energy of rotation. At any moment the viewer may collapse the excessive controls in the interface by unchecking the 'Show all interface elements' checkbox. Control of the camera view is achieved by manipulating the sliders at the top of the interface, which control camera latitude and longitude. Before starting the simulation, the user may enter initial values for the body orientation through three consecutive rotations along the three axes in the

space frame (see “Starting orientation” fields). Before clicking the ‘Start simulation’ button, the starting angular velocity may be set using the ‘Starting angular velocity’ fields. Note that the latter are set in the body frame. The learner may also select a body type from the drop-down select box in the upper-right of the interface. Then, by setting the body mass and dimensions in the corresponding fields below, the viewer will completely define the body characteristics and the moment of inertia tensor will be automatically calculated and displayed in the ‘Moment of inertia tensor’ fields (read-only). Note that the rigid body is homogenous.

After the simulation has started, the student may switch different viewing modes by the ‘View’ drop-down select box in the lower-left. The possible view modes include the inertial ellipsoid, Poinot construction in three variants and the Binet construction. The body may also be hidden by unchecking the checkbox ‘Show rigid body’ to allow better view of the constructions. When viewing the Poinot construction one should note that the polhode (the curve on the constraint ellipsoid) and the herpolhode (the curve on the invariable plane) are drawn by the angular velocity vector, while in the Binet construction the drawing vector is the angular momentum vector, which is restricted to point on the surfaces of the corresponding constraint ellipsoid and sphere.



Figure 2. Anaglyph stereoscopic 3D glasses. Left: red-cyan plastic frame glasses; center top: red-cyan paper frame glasses; right: green-purple plastic frame glasses.

At any moment, the student may switch the simulation into 3D-stereoscopic view mode by checking the 'Stereo mode' checkbox. Thus users may observe the process using red-cyan 3D-stereoscopic anaglyph glasses (see Figure 2 above).

You may maximize your browser window to enlarge the simulation or you may use the 'Full screen' button. In full screen mode you may not edit the simulation text fields. You need to switch back to normal view mode to edit these fields by clicking the 'Esc' key on your keyboard.