Kungl Tekniska Högskolan
Mekanik

2010 09 05

Rigid Body Dynamics, SG2150

Hand in assignments, batch 1, HT 2010

Due Friday 17/9

1) Solve Problem 1.11 at the end of Chapter 1, page 16, in Dynamics of Bodies. Thus: first prove that the cylinder will return only if $\omega > 2v/r$. *Also* calculate the distance along the floor the cylinder travels before it turns around and comes back assuming that $\omega = 3v/r$. Hint: In order for the cylinder to roll back the angular velocity must not have changed sign when $\dot{x}_G = 0$.

2) Solve Problem 2.3 at the end of Chapter 2, page 38, in Dynamics of Bodies. Hint: Note that the velocity of the contact point is the same as the velocity of the middle of the cylinder.

3) Assume that a rigid body is rotated from a reference orientation (where the Euler angles are zero) to a different orientation with Euler angles given by:

$$\psi = 45^\circ,\ \theta = 30^\circ,\ \varphi = 60^\circ$$

Write a program that calculates the resulting rotation matrix. Also find the rotation angle ϕ and the unit vector $(\cos\alpha_1, \cos\alpha_2, \cos\alpha_3)$ of the rotation axis for this rotation. Hint: you need formulas of Chapter 2, especially (2.29) and symmetry and anti symmetry of matrices. Use Matlab or Maple or whatever.

4) Solve Problem 3.6 at the end of Chapter 3, page 56, in Dynamics of Bodies. Hint use conservation of z-component of angular momentum with respect to the point C.

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