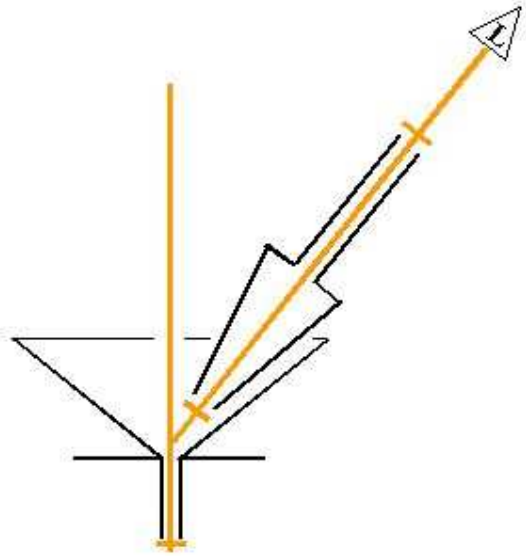
Nutation (2)

Aim: To give a geometric description of nutation

Subjects: 1Q50 (Gyros)

Diagram:

Parts



Assembly

Equipment:

- Model (see Diagram and Figures).

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Presentation: Watching a nutating object we observe that the body-axis makes a conical movement (see "Nutation 1" in this Database). This movement of the body-axis is visualized in our model by rotating the L-axis by hand (see Figures).

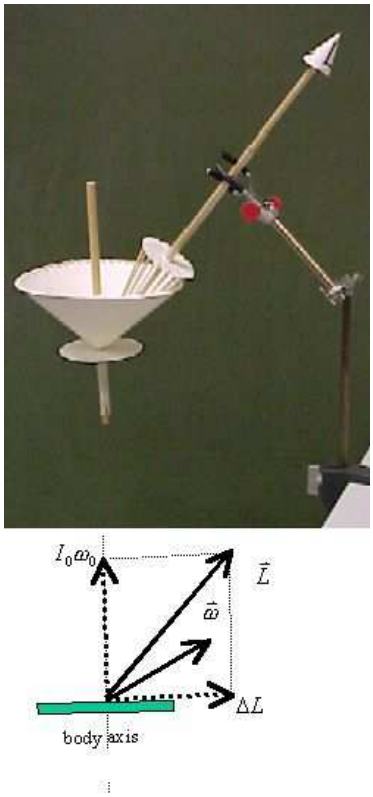

Figure 1

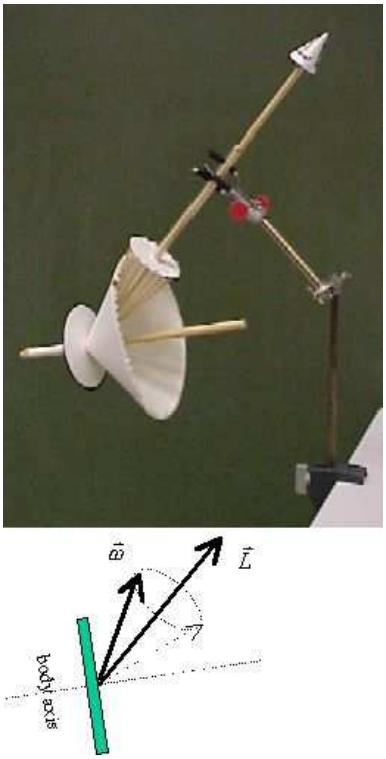

Figure 2

Explanation: L, ω and body-axis are in one plane. While moving, L remains fixed in space, so movement of that plane has to take place around L.
The fixed cone (so-called "space cone") contains ω and this ω turns around L. To show the position of ω with rerspect to the body axis, a cone around the body-axis (so-called body-cone) is visualized. This body-cone also contains ω. So in our model the position of ω is seen where the two cones touch each other. While rotating, the movement of the body-axis around L (nutation) and the movement of the momentary rotation-axis (ω) around the symmetry-axis can be observed.

Remarks:

- The model is made in such a way that the two cones grip each other (teeth on the inside of the rim of the body-cone grip the wooden bars of the space-cone), so that the cones are not slipping. This is needed since there is only one ω while in our model ω is in two cones.
- Our model represents the movement of a disk-shaped nutating object ($I_3>I_1$). Visualizing of a nutating bar-shaped object ($I_1>I_3$) needs a model having the body-cone revolving with its outside around a fixed space-cone.

Sources:

- Borghouts, A.N., Inleiding in de Mechanica, pag. 224-227
- Roest, R., Inleiding Mechanica, pag. 222-226

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