Advanced Dynamics
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Lecture – 60
Intermediate Axis Theorem

In this lecture, we will revisit the intermediate axis theorem discussed in one of the previous lectures.

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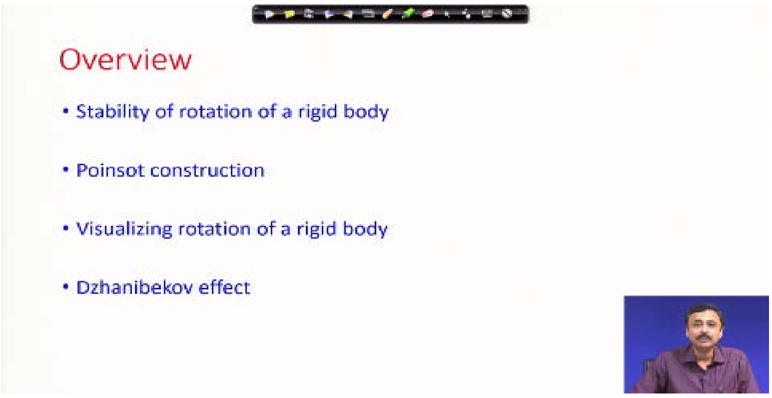

We are going to look at the stability of rotating rigid bodies and understanding the dynamics in terms of what are known as Poinsot construction. Then, we are going to see the Dzhanibekov effect which was observed by a Russian cosmonaut in space.

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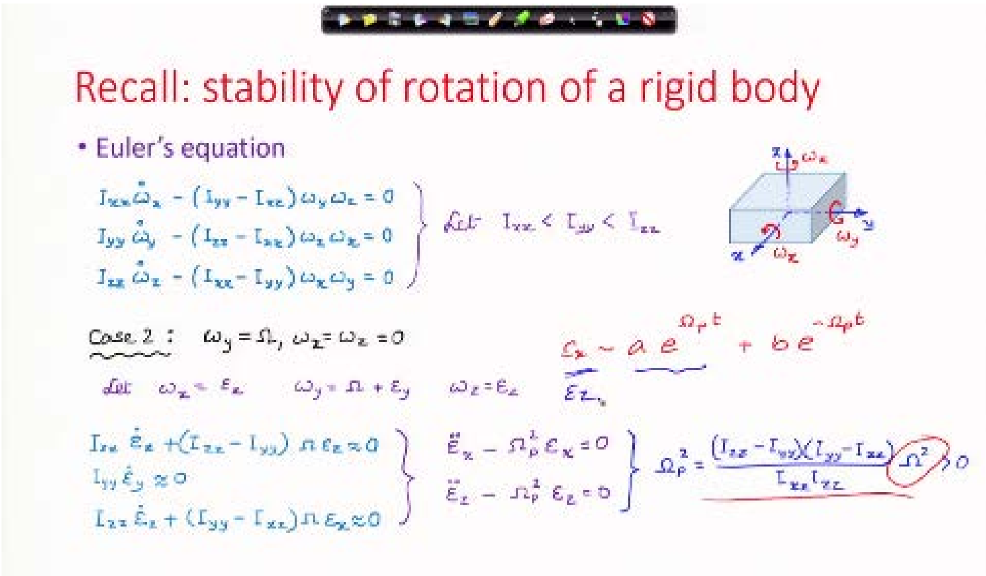

The linear stability of an unsymmetric spinning rigid body is revisited in the above slide.

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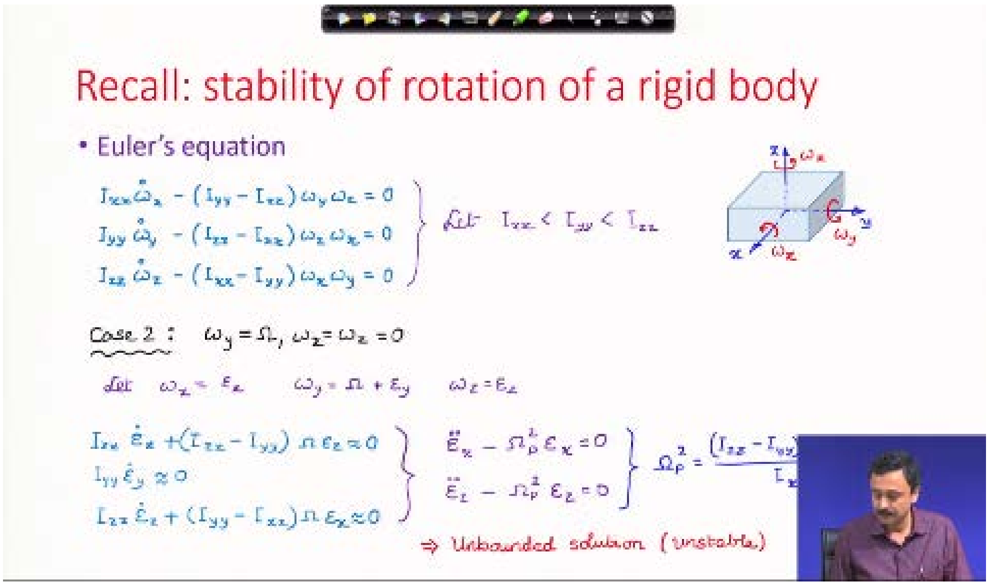

This linear stability analysis says that the spin about the intermediate axis has unbounded perturbation dynamics.

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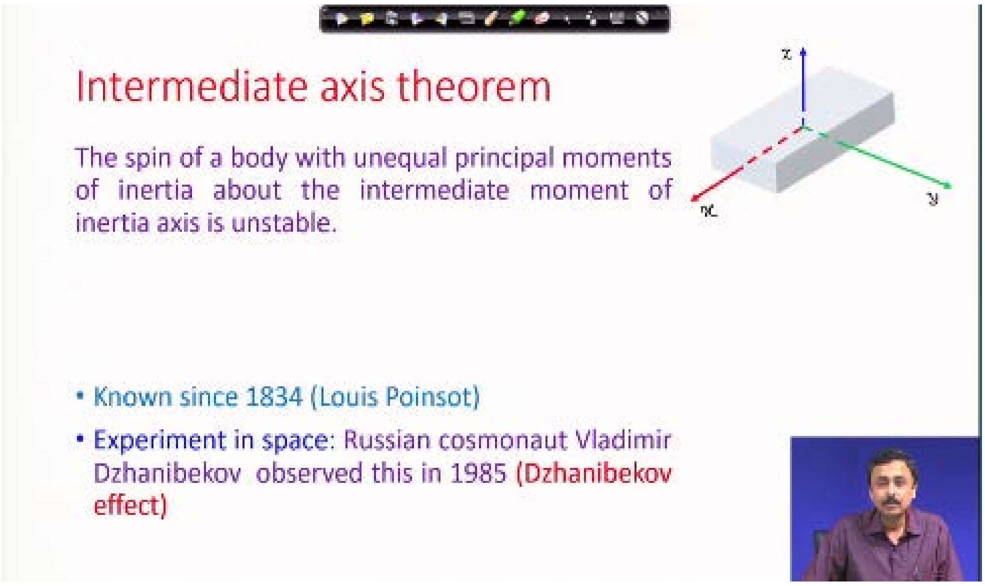

The intermediate axis theorem is stated in the above slide.

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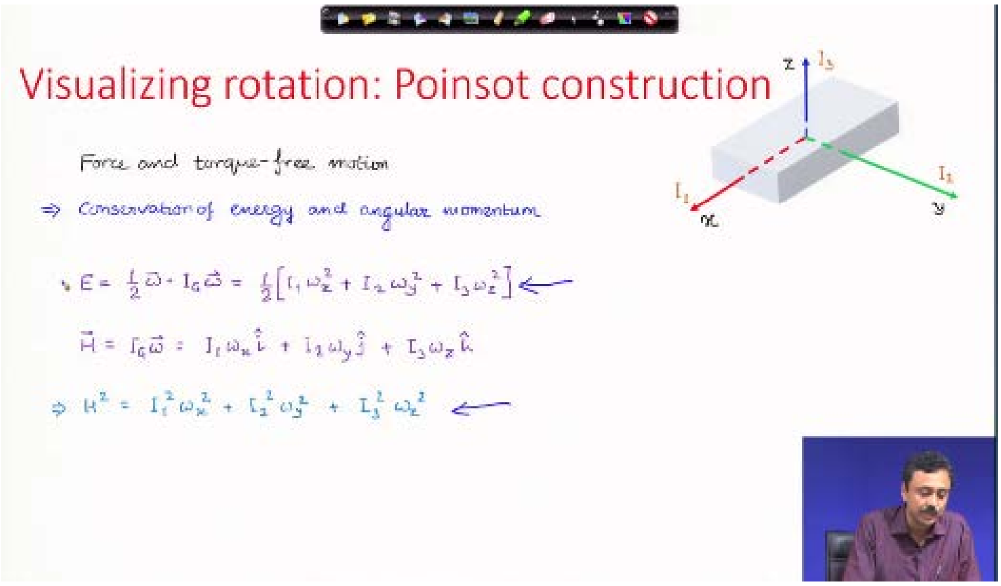

Poinsot devised an interesting way of visualizing the motion of a spinning rigid body. We start with the consideration that energy and angular momentum have to be conserved. These appear as constraints as presented in the slide above.

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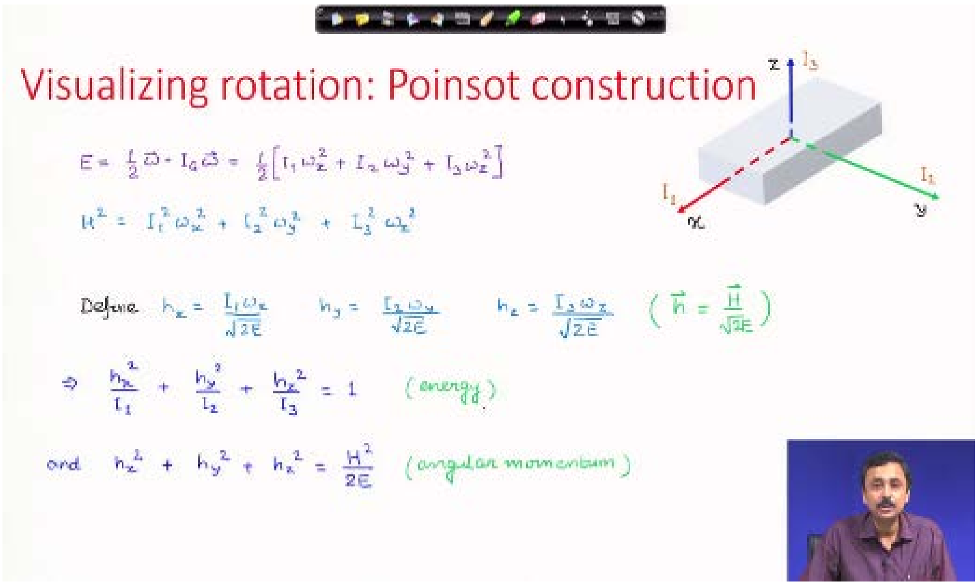

With a redefinition, we can recast the energy conservation constraint as an ellipsoid, and the angular momentum conservation constraint as a sphere, as presented in the above slide.

The Poinsot construction for the three cases of rotation, namely about the minimum, intermediate and maximum moment of inertia axes are presented in the following three slides.

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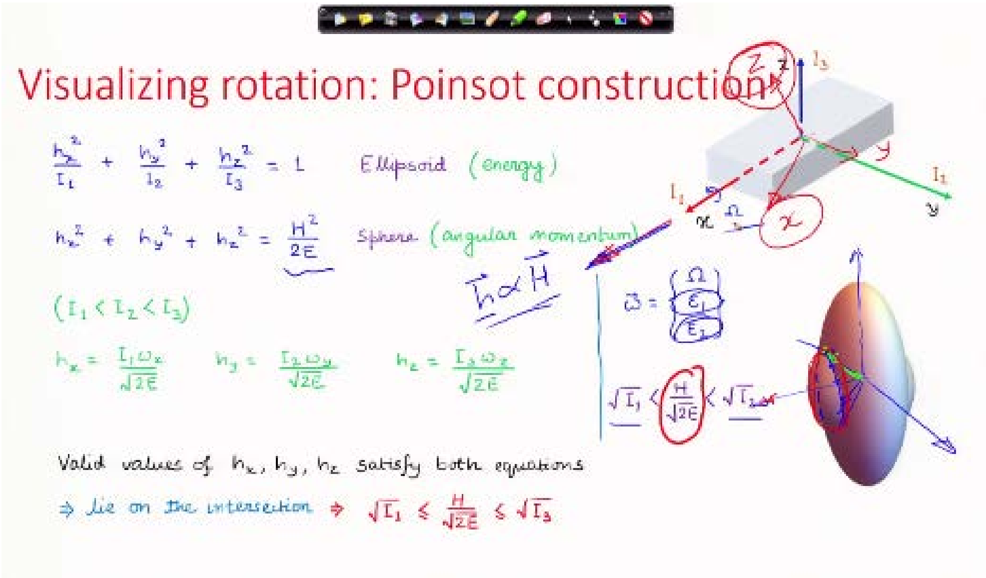

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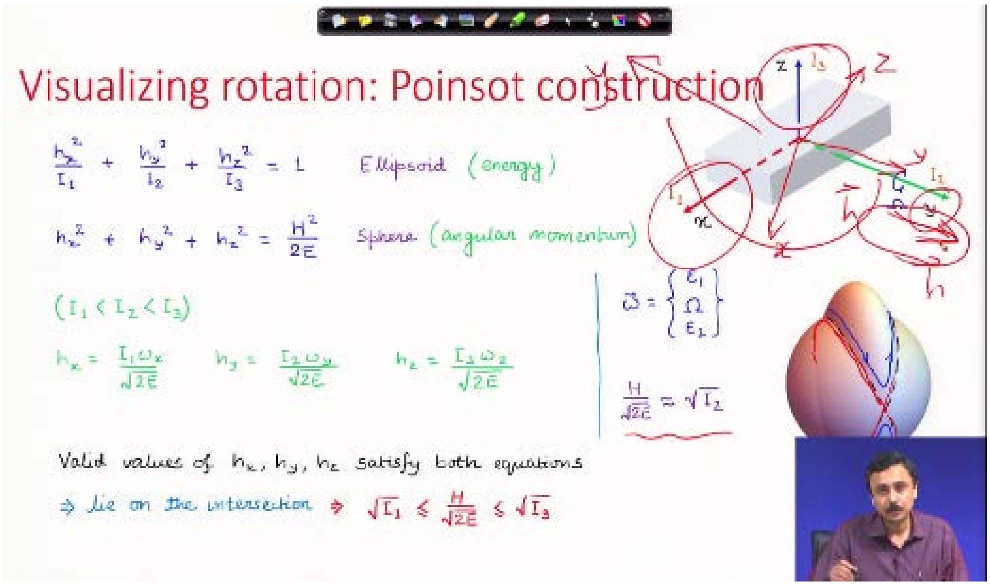

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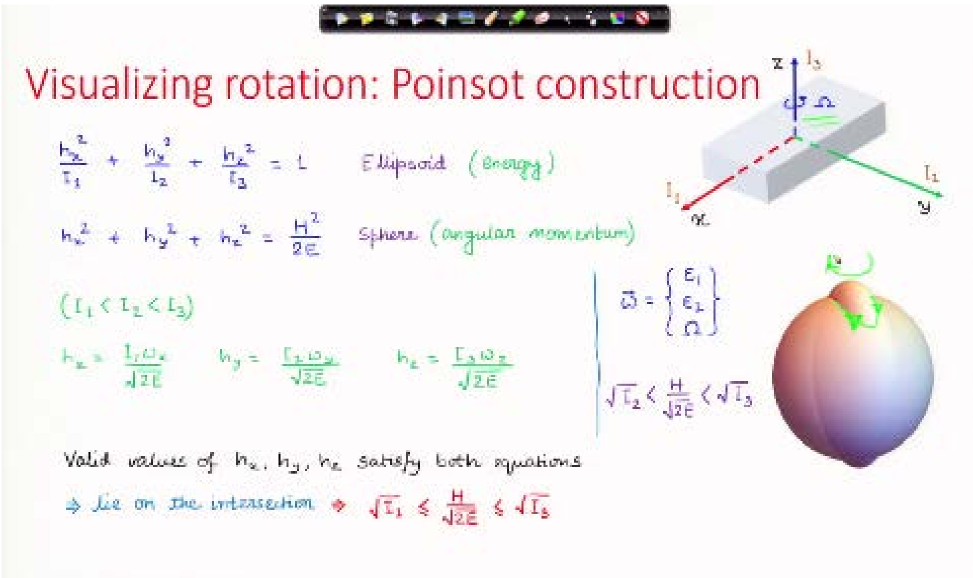

The maximum axis theorem is discussed in the following slide. This happens when there is dissipation of energy due to flexibility and internal damping.

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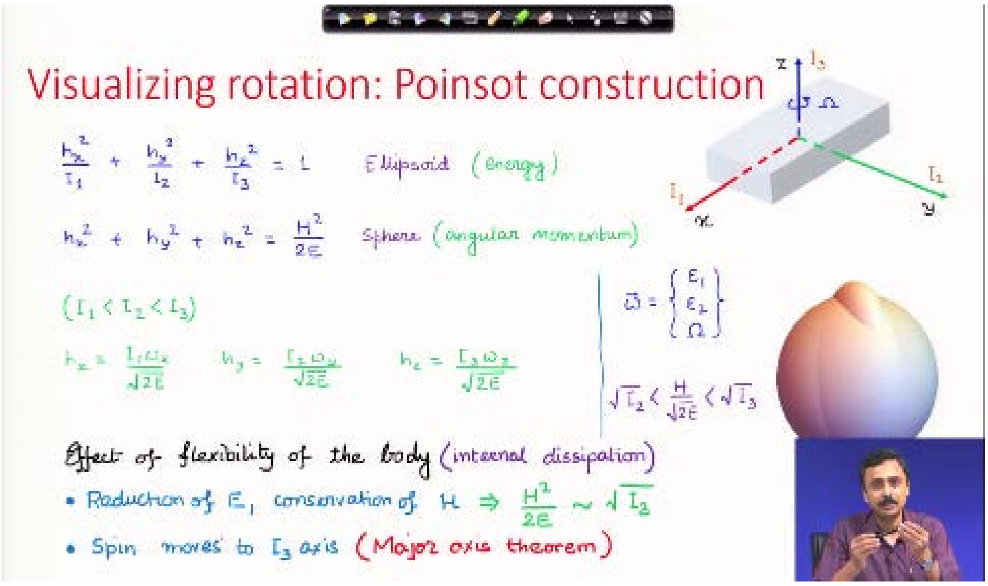

Now, we visualize the rotation through animations. The formulation is presented in the following 4 slides.

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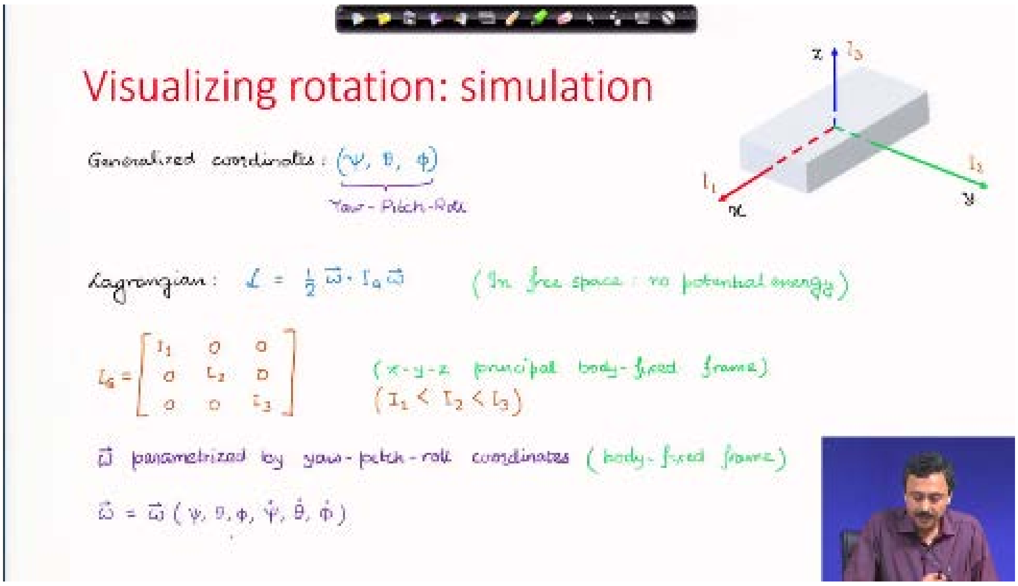

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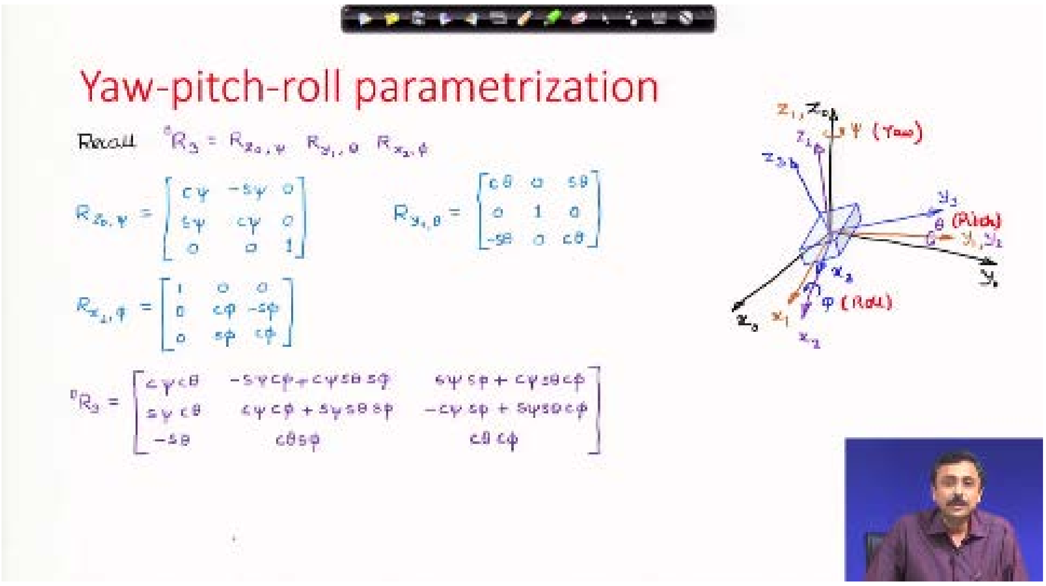

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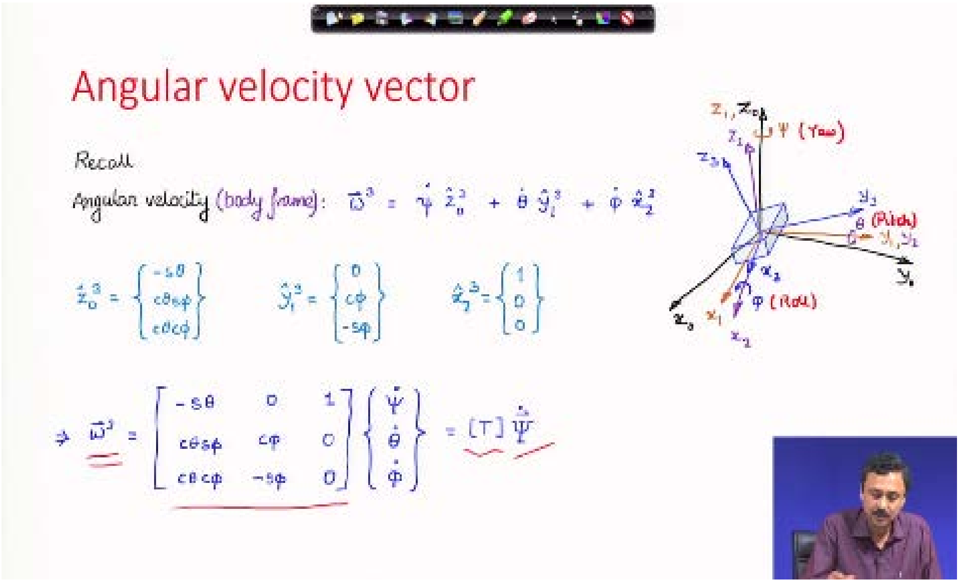

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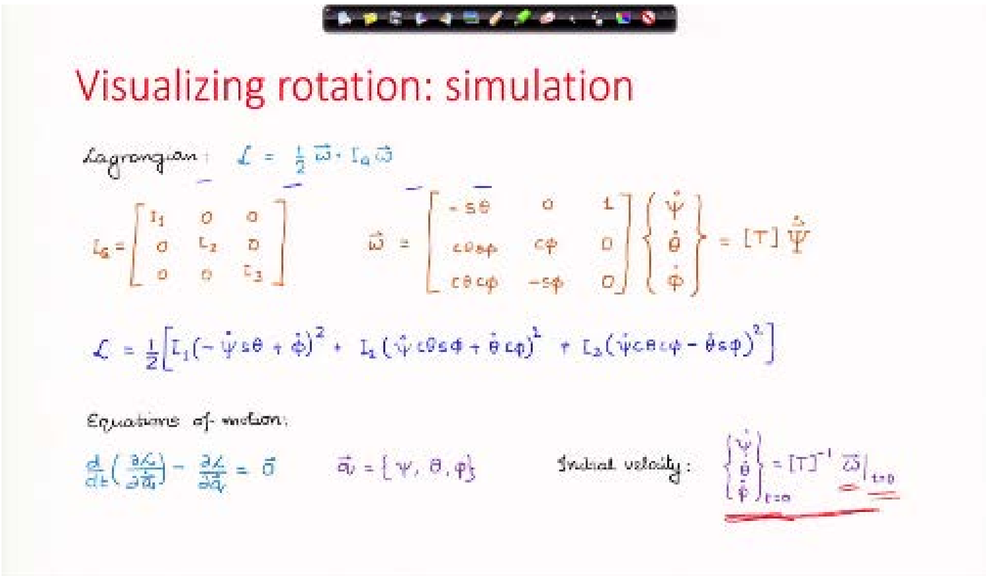

The simulation results are presented next in the lectures.

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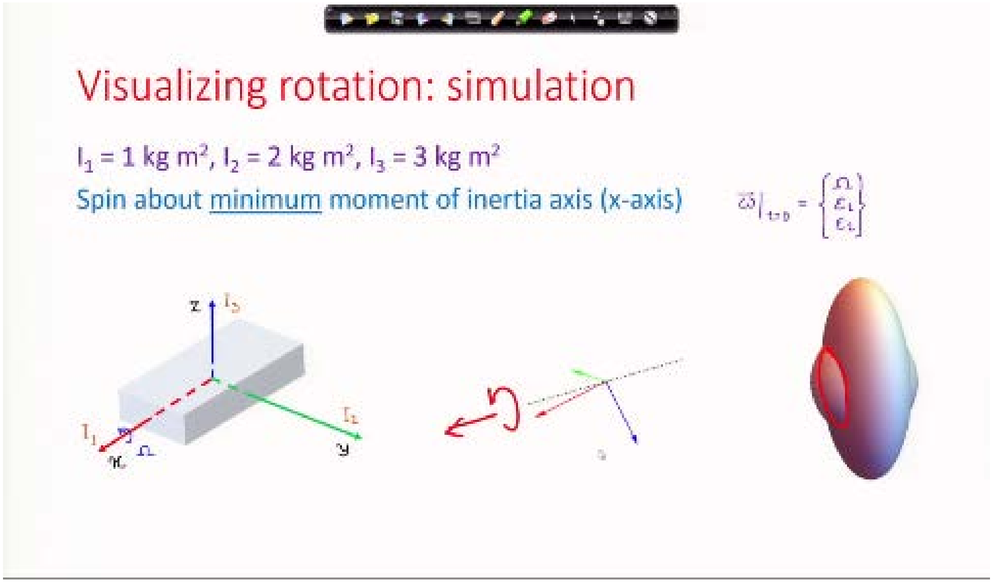

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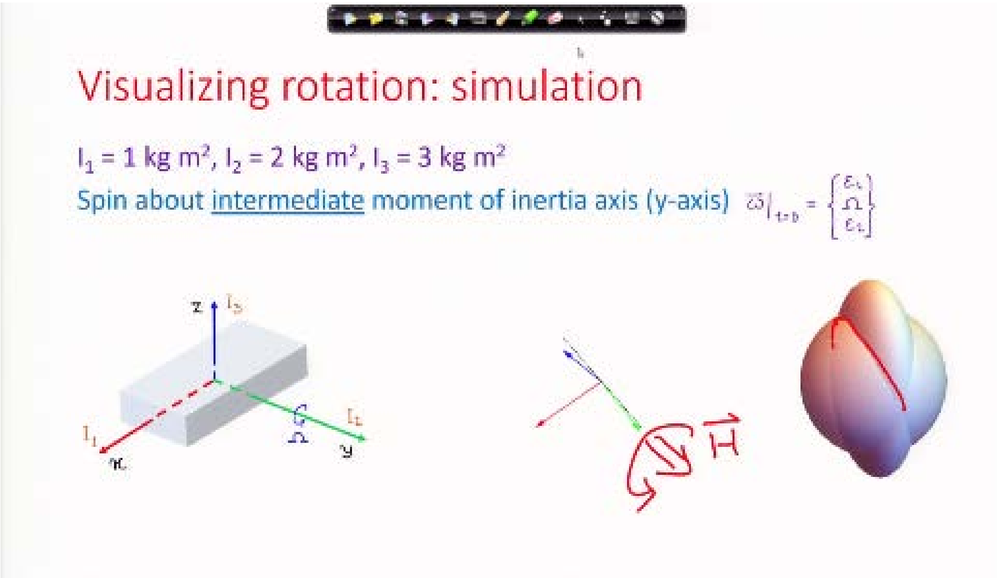

The Dzhanibekov effect is shown as a videl in the lecture along with the simulation.

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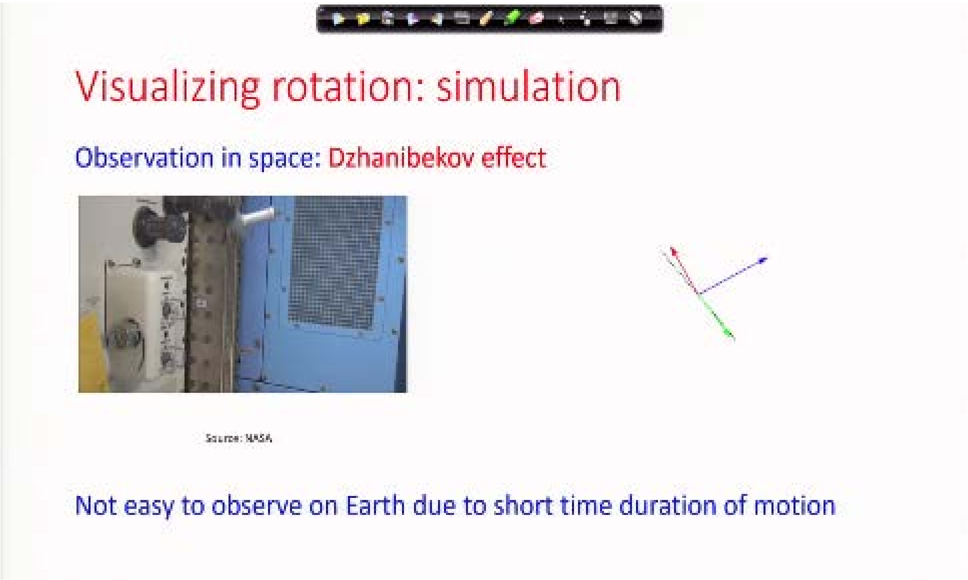

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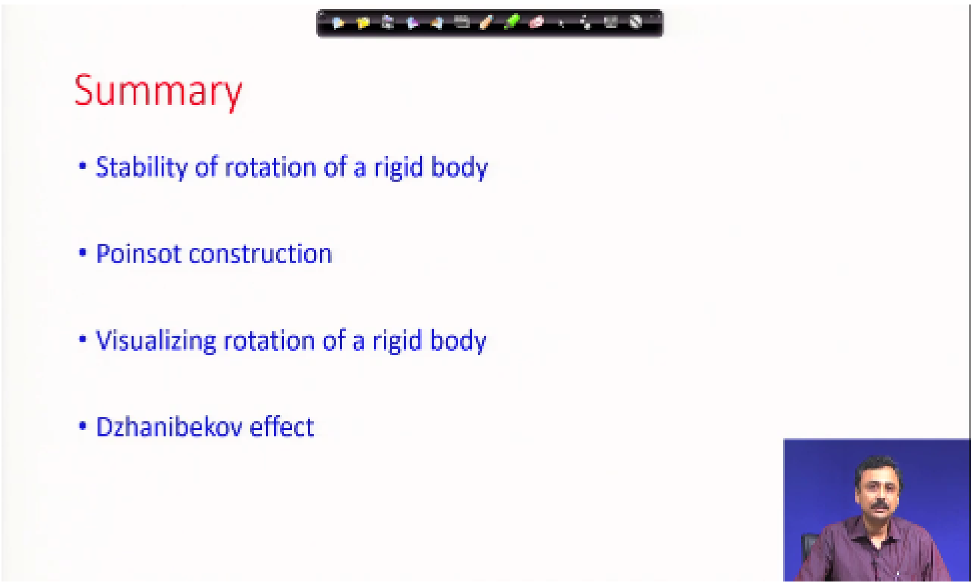

The summary is provided above.