

21.1: Introduction to Rigid Body Dynamics

Accordingly, we find Euler and D'Alembert devoting their talent and their patience to the establishment of the laws of rotation of the solid bodies. Lagrange has incorporated his own analysis of the problem with his general treatment of mechanics, and since his time M. Poinsôt has brought the subject under the power of a more searching analysis than that of the calculus, in which ideas take the place of symbols, and intelligent propositions supersede equations.

-James Clerk Maxwell

We shall analyze the motion of systems of particles and rigid bodies that are undergoing translational and rotational motion about a fixed direction. Because the body is translating, the axis of rotation is no longer fixed in space. We shall describe the motion by a translation of the center of mass and a rotation about the center of mass. By choosing a reference frame moving with the center of mass, we can analyze the rotational motion separately and discover that the torque about the center of mass is equal to the change in the angular momentum about the center of mass. For a rigid body undergoing fixed axis rotation about the center of mass, our

rotational equation of motion is similar to one we have already encountered for fixed axis rotation, $\vec{\tau}_{\text{cm}}^{\text{ext}} = d\vec{L}_{\text{cm}}^{\text{spin}}/dt$

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