MITOCW | MIT8_01F16_Intro_12_360p

We have previously studied the translational motion of rigid bodies by analyzing the motion of their center of mass.

We have also studied the rotation of rigid bodies about a fixed axis.

This week, we will consider more complicated examples of rigid body motion, where translation and rotation are both occurring simultaneously.

One example is, if I toss a rigid body through the air but give it a spin at the same time so that it tumbles in space as it falls.

A second example is a wheel that is rolling along a flat surface.

Its location is translating, but at the same time, it is also spinning about its axis.

A natural way to analyze such motions is to, once again, take advantage of [? Chasles' ?] theorem, which states that one possible way of describing the general motion of a rigid body is by a translation of its center of mass plus a rotation about its center of mass.

This separation of the general case into two distinct type of motions will greatly simplify our analysis.

One of the most common examples of simultaneous translational and rotational motion is that of rolling objects, and we will concentrate on this particular application.

We will see that an important detail is whether or not the object rolls without slipping, and the role that friction can play in each case.

The special case of rolling without slipping amounts to a constraint condition that relates the translational speed of the center of mass to the radius and the rotational angular velocity.