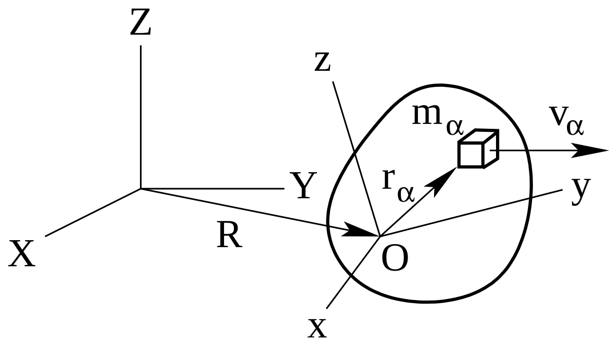
Dynamics of Rigid Bodies [mln24]

System with 6 degrees of freedom (3 translations and 3 rotations).

Equations of motion: $\dot{\mathbf{p}} = \mathbf{F}^{(e)}, \quad \dot{\mathbf{L}} = \mathbf{N}^{(e)}$ [mln2].

For the description of the rigid-body dynamics it is useful to introduce three coordinate systems:

- inertial coordinate system with axes (X, Y, Z),
- coordinate system with axes (x', y', z') parallel to (X, Y, Z) and origin O fixed to some point of the rigid body,
- coordinate system with axes (x, y, z) fixed to rigid body and with the same origin O as (x', y', z').



Motion of rigid body: $\mathbf{v}_\alpha = \dot{\mathbf{R}} + \vec{\omega} \times \mathbf{r}_\alpha$.

- *Translational* motion of (x', y', z') relative to (X, Y, Z).
- *Rotational* motion of (x, y, z) relative to (x', y', z').

The optimal choice of the origin O is dictated by the circumstances:

- for freely rotating rigid bodies, the center of mass is the best choice;
- for rigid bodies rotating about at least one point fixed in the inertial system, one such fixed point is a good choice.

Analysis of rigid body motion:

- Solve the equations of motion in the coordinate system (x, y, z). They are called *Euler's equations* [mln27].
- Transform the solution to the coordinate system (x', y', z') via *Eulerian angles* [msl25], [msl26] and from there to the inertial system (X, Y, Z).