12.7: Centrifugal Force

The centrifugal force was defined as

$$\mathbf{F}_{cf} = -m\omega \times (\omega \times \mathbf{r}'_{mov}) \tag{12.7.1}$$

Note that

$$\omega \cdot \mathbf{F}_{cf} = 0 \tag{12.7.2}$$

therefore the centrifugal force is perpendicular to the axis of rotation. Using the vector identity, equation $19.2.25$ allows the centrifugal force to be written as

$$\mathbf{F}_{cf} = -m[(\omega \cdot \mathbf{r}'_{mov})\omega - \omega^2 \mathbf{r}'_{mov}] \tag{12.7.3}$$

For the case where the radius $\mathbf{r}'$ is perpendicular to ω then $\omega \cdot \mathbf{r}' = 0$ and thus for this special case

$$\mathbf{F}_{cf} = m\omega^2 \mathbf{r}'_{mov} \tag{12.7.4}$$

The centrifugal force is experienced when riding in a car driven rapidly around a bend. The passenger experiences an apparent centrifugal (center fleeing) force that thrusts them to the outside of the bend relative to the inside of the turning car. In reality, relative to the fixed inertial frame, i.e. the road, the friction between the car tires and the road is changing the direction of the car towards the inside of the bend and the car seat is causing the centripetal (center seeking) acceleration of the passenger. A bucket of water attached to a rope can be swung around in a vertical plane without spilling any water if the centrifugal force exceeds the gravitation force at the top of the trajectory.

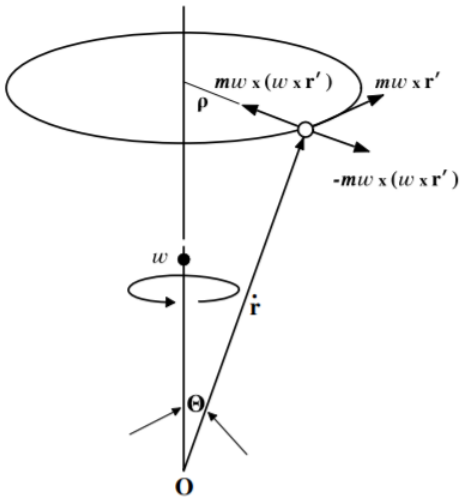

Figure 12.7.1: Centrifugal force.