

Accelerated reference frames and fake forces (non-relativistic)

Camera tracks inertial reference frame

$\Sigma \vec{F} = \vec{0} \quad \vec{a} = \vec{0}$
 $\Sigma \vec{F} \neq \vec{0} \quad \vec{a} \neq \vec{0}$
 $\vec{a} = \vec{0}$
 $\vec{a} = \vec{0}$

Newton's first law is not violated.

Camera tracks non-inertial reference frame

$\Sigma \vec{F} = \vec{0} \quad \vec{a} \neq \vec{0}$
 $\Sigma \vec{F} \neq \vec{0} \quad \vec{a} = \vec{0}$
 $\vec{a} = \vec{0}$
 $\vec{a} = \vec{0}$

Newton's first law is violated.

Tell a lie while camera tracks non-inertial reference frame

Add a fictitious force to each mass to make it seem as though Newton's first law is not violated in this frame.

Magnitude: $F_{\text{FICT}} = ma_{\text{NON-INERTIAL}}$
 Direction: Opposite acceleration of non-inertial frame relative to inertial frame

$\Sigma \vec{F} \neq \vec{0} \quad \vec{a} \neq \vec{0}$
 $\Sigma \vec{F} = \vec{0} \quad \vec{a} = \vec{0}$
 $\vec{a} = \vec{0}$
 $\vec{a} = \vec{0}$

Newton's first law no longer *appears* to be violated.

Vocabulary

Apparent gravitational force:

$$\vec{F}_G + \vec{F}_{\text{FICT}} = \vec{F}_{G \text{ EFFECTIVE}}$$