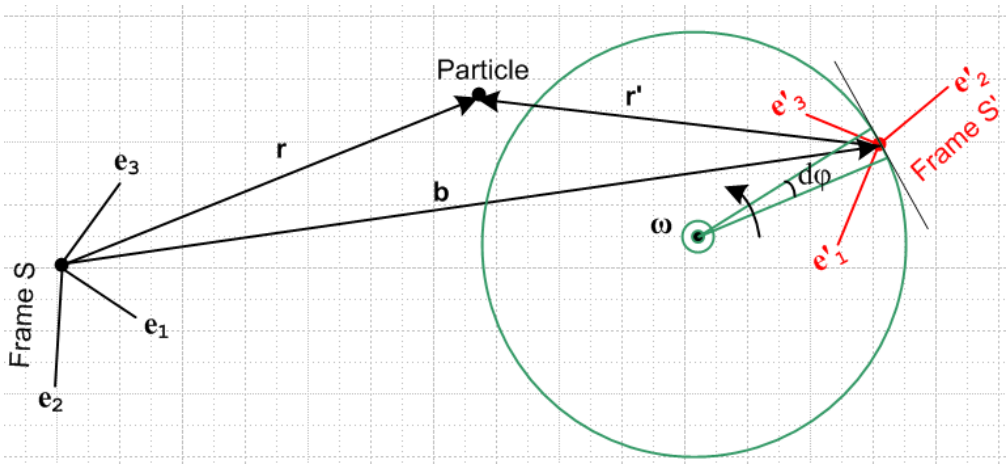
New Section 13.3

This is installed, do not view again.

I should just start with Section 12.1 and edit it using the Swap Rules! I will make red after I edit each equation with the Swap Rules.



(12.1)

Definitions and Equations

r', v', a'	position, natural velocity and natural acceleration in Frame S'
r, v, a	position, natural velocity and natural acceleration in Frame S
ω	angular velocity of Frame S relative to Frame S'
b	vector directed from origin of Frame S' to origin of Frame S

$$\mathbf{r} = \mathbf{b} + \mathbf{r}' \qquad (6.1)$$

$$\mathbf{v} = \mathbf{v}' + \boldsymbol{\omega} \times \mathbf{r}' + \dot{\mathbf{b}}_S \qquad (6.6a)$$

$$\mathbf{v} = \mathbf{v}' + \boldsymbol{\omega} \times \mathbf{r} + \dot{\mathbf{b}}_{S'} \qquad (6.6c)$$

$$\mathbf{a} = \mathbf{a}' + \dot{\boldsymbol{\omega}} \times \mathbf{r}' + 2\,\boldsymbol{\omega} \times \mathbf{v}' + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}') + \ddot{\mathbf{b}}_S \qquad (7.6a)$$

S S' Euler Coriolis centripetal frame

$$\mathbf{a} = \mathbf{a}' + \dot{\boldsymbol{\omega}} \times \mathbf{r} + 2\,\boldsymbol{\omega} \times \mathbf{v}' + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) + 2\boldsymbol{\omega} \times \dot{\mathbf{b}}_{S'} + \ddot{\mathbf{b}}_{S'} \qquad (7.6b)$$

$$\mathbf{L}^{(c)} = \mathbf{L}'^{(c')} + (\mathbf{r}' - \mathbf{c} + \mathbf{b})\,(\boldsymbol{\omega} \times \mathbf{r}' + \dot{\mathbf{b}}_S) + (\mathbf{c}' - \mathbf{c} + \mathbf{b}) \times \mathbf{v}' \qquad (11.2.14)$$

$$\dot{\mathbf{L}}^{(c)} = \dot{\mathbf{L}}'^{(c')} + (\mathbf{c}' - \mathbf{c} + \mathbf{b}) \times \mathbf{a}' - \dot{\mathbf{c}}_S \times [\mathbf{v}' + \boldsymbol{\omega} \times \mathbf{r}' + \dot{\mathbf{b}}_S] + \dot{\mathbf{c}}'_{S'} \times \mathbf{v}'$$
$$+ (\mathbf{r}' - \mathbf{c} + \mathbf{b}) \times [\dot{\boldsymbol{\omega}} \times \mathbf{r}' + 2\,\boldsymbol{\omega} \times \mathbf{v}' + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}') + \ddot{\mathbf{b}}_S] \qquad (11.2.15)$$

Fictitious Forces (Section 8)

For using fictitious forces we have (Frame S is inertial)

$\mathbf{F} = m\mathbf{a}$ // true Newton's Law in inertial Frame S *(8.1.2)*

$\mathbf{F'}_{\mathtt{eff}} = m\mathbf{a'}$ // fake Newton's Law in rotating Frame S' *(8.1.4)*

$$\mathbf{F'}_{\mathtt{eff}} = \mathbf{F} + \mathbf{F'}_{\mathtt{fict}} \ . \qquad (8.1.7)$$

For the general case, the fictitious forces can be expressed as

$$\mathbf{F'}_{\mathtt{fict}} = \underbrace{-m\ddot{\mathbf{b}}_{\mathtt{S}}}_{\text{frame}} \underbrace{-m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r'})}_{\text{centrifugal}} \underbrace{-2m\,\boldsymbol{\omega} \times \mathbf{v'}}_{\text{Coriolis}} \underbrace{-m\dot{\boldsymbol{\omega}} \times \mathbf{r'}}_{\text{Euler}} \ . \qquad (8.1.8)$$

For Special Case # 1 problems ($\boldsymbol{\omega}$ axis passes through Frame S origin), we have

$$\mathbf{F'}_{\mathtt{fict}} = \underbrace{-m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r})}_{\text{centrifugal}} \underbrace{-2m\,\boldsymbol{\omega} \times \mathbf{v'}}_{\text{Coriolis}} \underbrace{-m\dot{\boldsymbol{\omega}} \times \mathbf{r}}_{\text{Euler}} \ . \qquad \text{Special Case \#1} \qquad (8.4.1)$$

Fictitious Torques (Section 11)

$$\mathbf{N'}^{(\mathtt{c'})}_{\mathtt{fict}} = -(\mathbf{c'} - \mathbf{c} + \mathbf{b}) \times m\mathbf{a'} + \dot{\mathbf{c}}_{\mathtt{S}} \times [m\mathbf{v'} + m\boldsymbol{\omega} \times \mathbf{r'} + m\dot{\mathbf{b}}_{\mathtt{S}}] - \dot{\mathbf{c}}'_{\mathtt{S}'} \times m\mathbf{v'}$$
$$-(\mathbf{r'} - \mathbf{c} + \mathbf{b}) \times [\, m\dot{\boldsymbol{\omega}} \times \mathbf{r'} + 2m\boldsymbol{\omega} \times \mathbf{v'} + m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r'}) + m\ddot{\mathbf{b}}_{\mathtt{S}}] \qquad (11.3.8)$$

where the second line is just $(\mathbf{r'} - \mathbf{c} + \mathbf{b}) \times \mathbf{F'}_{\mathtt{fict}}$ from (8.6).