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9. Notation comparison with Marion (1970) and Thornton & Marion (2003)

In this we Section compare our notation for rotating-frame kinematics and non-inertial-frame physics to that of Marion (1970) and Thornton and Marion (T&M 2003).

Their notation is close to our "swap" notation, so before making any comparisons, we restate various of our equations in swap notation. A swap notation equation has an S subscript on the equation number and is obtained from the corresponding non-swap equation by prime ↔ noprime (**b** and **ω** do not change) :

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

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

$$\mathbf{F}' = m\mathbf{a}' = m\ddot{\mathbf{b}}_{S'} + m\mathbf{a} + m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) + 2m\,\boldsymbol{\omega} \times \mathbf{v} + m\dot{\boldsymbol{\omega}} \times \mathbf{r} \qquad (8.1.3)_S$$

$$m\mathbf{a} = \mathbf{F}_{\mathbf{eff}} = \mathbf{F}' - m\ddot{\mathbf{b}}_{S'} - m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) - 2m\,\boldsymbol{\omega} \times \mathbf{v} - m\dot{\boldsymbol{\omega}} \times \mathbf{r} \qquad (8.1.5)_S$$

In the above swap notation equations, Frame S' is fixed (f) and Frame S is the rotating frame (r) :

We now compare these equations with those of the Marion series authors:

$$\mathbf{r}' = \mathbf{b} + \mathbf{r} \qquad (6.1)_S$$
$$\mathbf{r}' = \mathbf{R} + \mathbf{r}$$
// Marion p 341 (11.1)
// T&M p 388 (10.1)

$$\mathbf{v}' = \mathbf{v} + \boldsymbol{\omega} \times \mathbf{r} + \dot{\mathbf{b}}_{S'} \qquad (6.6a)_S$$
$$\mathbf{v}_f = \mathbf{v}_r + \boldsymbol{\omega} \times \mathbf{r} + \mathbf{V}$$
// Marion p 344 (11.12)
// T&M p 391 (10.17)

$$\mathbf{F}' = m\mathbf{a}' = m\ddot{\mathbf{b}}_{S'} + m\mathbf{a} + m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) + 2m\,\boldsymbol{\omega} \times \mathbf{v} + m\dot{\boldsymbol{\omega}} \times \mathbf{r} \qquad (8.1.3)_S$$
$$\mathbf{F} = m\mathbf{a}_f = m\ddot{\mathbf{R}}_f + m\mathbf{a}_r + m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) + 2m\,\boldsymbol{\omega} \times \mathbf{v}_r + m\dot{\boldsymbol{\omega}} \times \mathbf{r}$$
// Marion p 344 (11.17)
// T&M p 392 (10.23)

$$m\mathbf{a} = \mathbf{F}_{\mathbf{eff}} = \mathbf{F}' - m\ddot{\mathbf{b}}_{S'} - m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) - 2m\,\boldsymbol{\omega} \times \mathbf{v} - m\dot{\boldsymbol{\omega}} \times \mathbf{r} \qquad (8.1.5)_S$$
$$m\mathbf{a}_r = \mathbf{F}_{\mathbf{eff}} = \mathbf{F} - m\ddot{\mathbf{R}}_f - m\boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) - 2m\,\boldsymbol{\omega} \times \mathbf{v}_r - m\dot{\boldsymbol{\omega}} \times \mathbf{r}$$
// Marion p 344 (11.19)
// T&M p 392 (10.25)

Based on these comparisons, we make the following translation table:

our swap notation	Marion authors	
S	r	name of the rotating frame (r = rotating)
S'	f	name of the fixed frame (f = fixed)

$\partial_{\mathtt{S}}$	$(d/dt)_{\mathtt{rotating}}$	time derivative in the rotating frame
$\partial_{\mathtt{S'}}$	$(d/dt)_{\mathtt{fixed}}$	time derivative in the fixed frame
$\mathbf{r}$	$\mathbf{r}$	position in rotating frame
$\mathbf{v}$	$\mathbf{v}_{\mathtt{r}}$	velocity in rotating frame
$\mathbf{a}$	$\mathbf{a}_{\mathtt{r}}$	acceleration in rotating frame
$\mathbf{r'}$	$\mathbf{r'}$	position in fixed frame
$\mathbf{v'}$	$\mathbf{v}_{\mathtt{f}}$	velocity in fixed frame
$\mathbf{a'}$	$\mathbf{a}_{\mathtt{f}}$	acceleration in fixed frame
$\mathbf{F'}$	$\mathbf{F}$	force in fixed frame = true force in rotating frame
$\mathbf{F}_{\mathtt{eff}}$	$\mathbf{F}_{\mathtt{eff}}$	total effective force in the rotating frame
$\mathbf{F}_{\mathtt{fict}}$		total fictitious force in the rotating frame
$\mathbf{b}$	$\mathbf{R}$	location of the rotating frame origin (measured in the fixed frame)
$\dot{\mathbf{b}}_{\mathtt{S'}}$	$\dot{\mathbf{R}}_{\mathtt{f}}$,$\mathbf{V}$	velocity of the rotating frame origin (measured in the fixed frame)
$\ddot{\mathbf{b}}_{\mathtt{S'}}$	$\ddot{\mathbf{R}}_{\mathtt{f}}$	acceleration of the rotating frame origin (measured in the fixed frame)