Summary of this folder PhL 3.26.17

I wasted a whole day on this little study which I will now explain was done completely wrong, so all the other docs in this folder are completely wrong.

MAIN POINT

First, my Appendix I on Rigid Body Dynamics makes use of two reference Frames, one of which is embedded into the rotating object of interest. As I say in the very first line:

1.1 The Appearance of the Inertia Tensor

Assume that Frame S' is embedded into a rigid body, so that Frame S' and that rigid body are rotating at

I go on in that Appendix I to develop equations of motion for a rigid body in such a situation,

$$(N)'_1 = I'_1 (\dot{\omega})'_1 - (\omega)'_2(\omega)'_3 (I'_2 - I'_3)$$
$$(N)'_2 = I'_2 (\dot{\omega})'_2 - (\omega)'_3(\omega)'_1 (I'_3 - I'_1)$$
$$(N)'_3 = I'_3 (\dot{\omega})'_3 - (\omega)'_1(\omega)'_2 (I'_1 - I'_2) \ . \qquad \text{(I.4.3)}$$

These are the "rigid body equations of motion" in body frame components, where I have already chosen the body frame axes to diagonalize the inertia tensor.

Now we change the scene. In Appendix F I analyze the dumbbell satellite problem. In that problem, one Frame of reference is in orbit going around the earth. This is a non-inertial frame. A second frame is embedded into a non-rotating Earth.

Neither of these frames is embedded into the rotating dumbbell body, so in Appendix F neither frame is the body frame of the dumbbell!!!!! Thus, the equations (I.4.3) I show above having nothing at all to do with the dumbbell satellite problem!! So all my work in the three docs in this folder is meaningless!

HOW WOULD YOU DO A RIGID BODY ANALYSIS?

I think this would be quite a pain to do. You would need a *third* Frame perhaps Frame S" which is embedded into the dumbbell. Then Frame S is the sky frame that is also non-inertial and Frame S' is the ground inertial frame.

Suppose then we consider only the two non-inertial frames S" embedded into rotor, and S in the sky. I think you could go ahead and write $\mathbf{L} = I\boldsymbol{\omega}$ and have the usual I_{ij} which you could evaluate in any frame. I don't think anything in Section I.2 requires that Frame S be inertial, which is good since it is non-inertial.

But then I say :

From (11.3.2) Newton's Second Law (angular motion) applied in inertial Frame S states,

$$\mathbf{N} = \dot{\mathbf{L}} \qquad // \ \dot{\mathbf{L}} = \partial_{\mathbf{S}}\mathbf{L} = (d\mathbf{L}/dt)_{\mathbf{S}} \qquad \text{(I.2.1)}$$

This would not be true in the sky frame S, so the resulting (I.4.3) would be invalid,.

Conclusion: To do this problem right, you have to manage THREE frames of reference.

Then you use frames doc to establish how each pair of frames is related.

You might try to use $\mathbf{N}_{\mathbf{eff}} = \dot{\mathbf{L}}$ for the sky frame S where you include a fictitious force to account for the fact that the sky frame is non-inertial. You end up with some equations of motion which is different from the set (I.4.3) above.

I really have no interest in attempting this problem at this time.