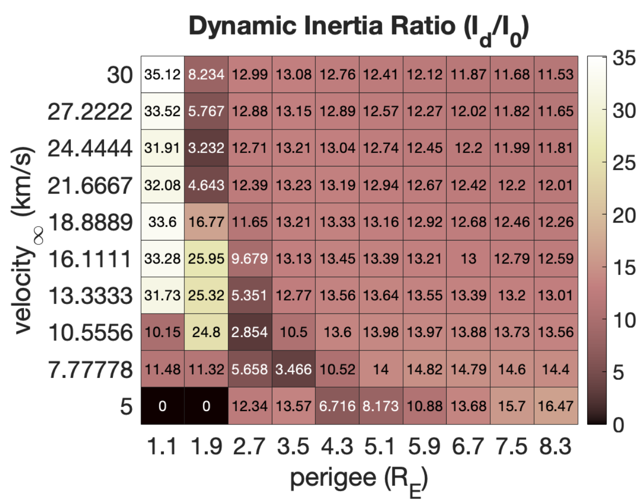
Report20230925

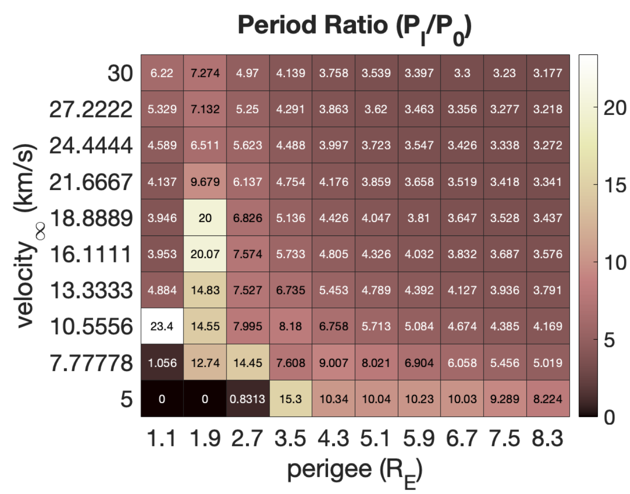
Summary:

- Dynamic Inertia is not a good index to monitor the mass shifting, because it includes the changes of rotation. The dynamics inertia $I_d = H^2/2K$ do not pull the rotation component out.
- The determinant of global moment of inertia $I_g = \sum(I_i + m_i[\tilde{r}_i][\tilde{r}_i]^T)$ is a correct way to monitor mass shifting, but the S/N is terrible. Some minor changes are usually immersed by error.
- Then the sum of shifting distance would be the better way to monitor mass shifting. The only calculation involved is the addition, the S/N is much better than the determinant of the global moment of inertia I_g.

1. Dynamic Inertia

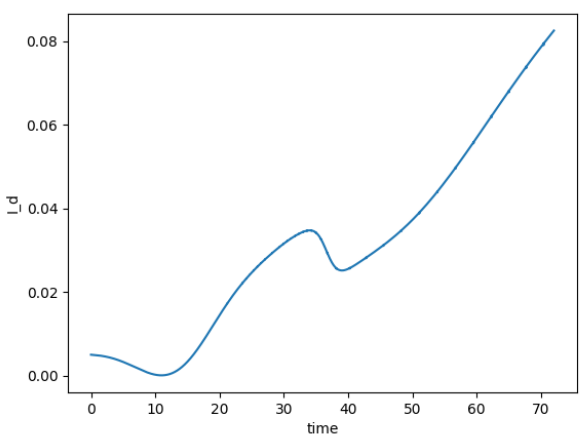


Dynamic Inertia

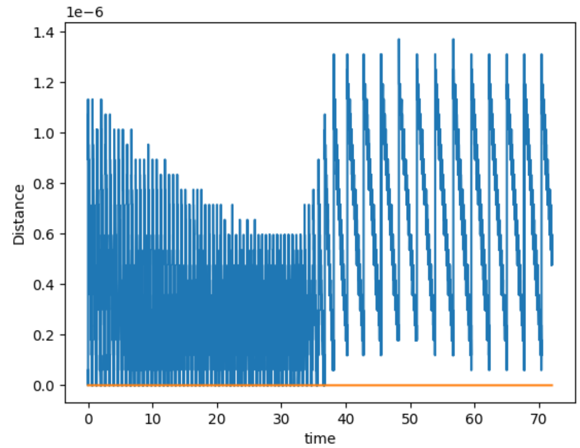


Period Ratio

Then I sampled several blocks to check the real mass shifting, then, I found the dynamic inertia is not good enough to monitor the mass shifting. For example, the right-bottom block ($q = 8.3R_E, v_\infty = 5\ km/s$) shows a big shifting relative to other conditions, but the real is not.



Dynamic Inertia change for example case



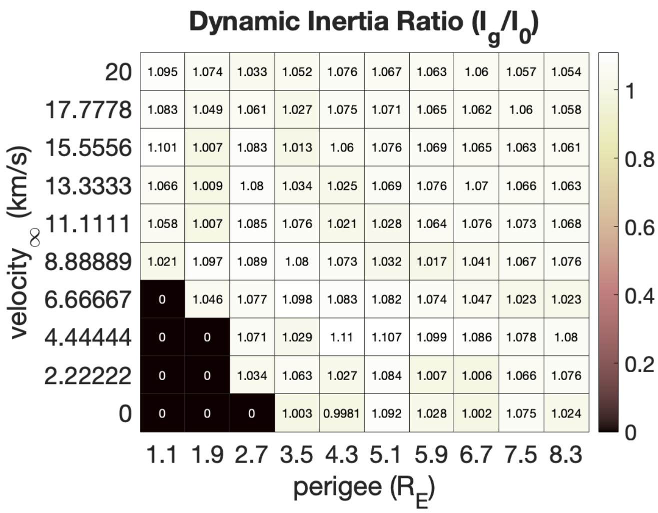
relative distance change for example case

Also, the animation doesn't show any obvious shift

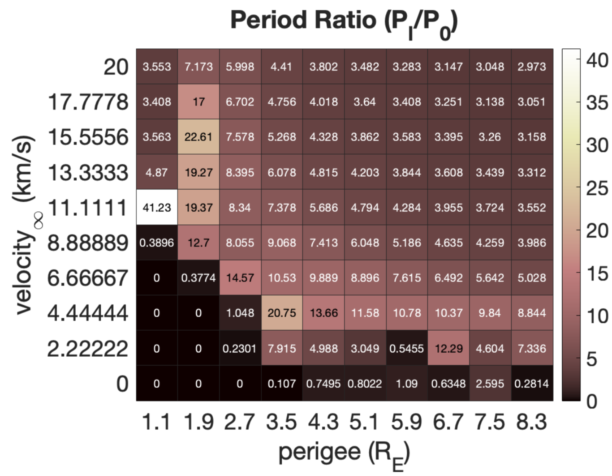
2. The determinant of global moment of inertia

The global moment of inertia depends on the body-fixed inertia, its mass, and its relative position w.r.t CM. The body-fixed inertia and its mass are constants, is the relative positions changes, I expect to observe some changes in the global moment of inertia.

$$det(I_g) = det[\sum(I_i + m_i[\tilde{r}_i][\tilde{r}_i]^T)] \tag{1}$$

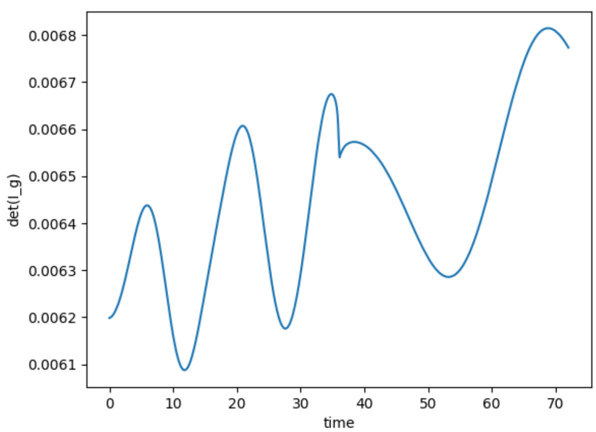


Global Inertia determinant

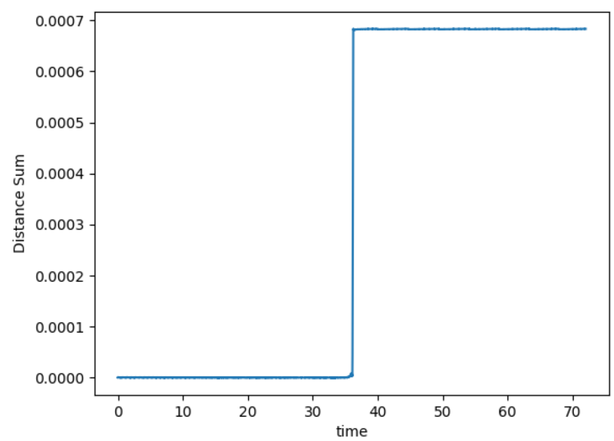


Period Ratio

Same, I pick an example ($q = 1.1R_E, v_\infty = 11.111\ km/s$) shows little mass shift, but actually, the shift is totally observable by monitoring relative distance. Here, I think the computation error about 0.0007, but the change in global inertia is 0.0001.



Global Inertia change for example case



relative distance change for example case