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Readme file for Solver.py

Attitude Determination and Control Subsystem

rk4Quaternion(sat,f,h)

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This function gives next state.
Input: Object of satellite class, the differential equation governing change of state, integration time step.
Output: Next state (q_{BI} and w_{BIB})

We are integrating wrt error state due to numerical stability. So, first we obtain q_{BO} and w_{BOB} using given satellite state (q_{BI} and w_{BIB}) and position and velocity information obtained from satellite class.
Then, Runge-Kutta method for integration have been used for integration. [1]

$$y_{j+1} = y_j + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4) \tag{1}$$

where

$$k_1 = hf(x_j, yj), \tag{2}$$
$$k_2 = hf(x_j + \frac{h}{2}, y_j + \frac{k_1}{2}), \tag{3}$$
$$k_3 = hf(x_j + \frac{h}{2}, y_j + \frac{k_2}{2}), \tag{4}$$
$$k_4 = hf(x_j + h, y_j + k_3) \tag{5}$$

In next step, quaternion is divided by its norm to obtain unit quaternion as a unit quaternion is required for rotation.

Then using the new values of q_{BO} and w_{BOB}, we obtain q_{BI} and w_{BIB}. But it is modified as a quaternion with positive scalar component is required. So, an if condition is used to check for negative scalar values and if the condition is true then original quaternion is replaced with its negation.

References

[1] S Baskar and S Sivaji Ganesh. “Introduction to Numerical Analysis”. In: (2005).