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Readme file for Solver.py

Attitude Determination and Control Subsystem

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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.
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, 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).