Simulation: Attitude Dynamics

You have to create a attitude dynamics simulation of a satellite in 3D motion and run it for a "real" system. Your primary focus is on orientation and so the simulation of translational (or orbital) dynamics is not required. The simulation can be of a satellite with a 3D initial angular velocity with no applied control forces (tumbling satellite). The simulation can be done in MATLAB using ODE45 or using any other code. You have to conduct the simulation three different ways:

- using direction cosine matrix
- using orientation angles (choose your space or body, 2 or 3 axis, angles)
- using orientation parameter (choose one of Euler, Rodrigues, or Wiener-Milenkovic)

You will have to compare and verify (using conservation of angular momentum and/or conservation of energy) the three sets of results. You will need to pay attention to any singularities or issues in time marching.

I have created a discussion topic for this topic: Attitude Dynamics Simulation. I expect everyone to participate - you are free to talk about assumptions you are making, coding strategies, strategies to counter singularities, and how you are validating/verifying you code. You cannot share your code or your report. The minimum deliverables are:

- Video about the simulation embedded in the discussion which should have:
    - Short presentation to give context
    - Animation of the simulation
- Report of the project submitted to this assignment which should include the following sections:
    - Three sets of kinematic equations
    - Verification of simulation
    - Comparison of various simulations
- Code(s)

Feel free to do extra work ☺. For example:

1. Simulate the system for interesting initial conditions to demonstrate the intermediate axis theorem.
2. Simulate a feedback controlled system to reduce tumbling, e.g. apply moments {M} = - k {omega}.
3. Simulate the pointing of the satellite by designing a controller to change the orientation from an initial to final orientation in a given time.