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# DESIGN AND IMPLEMENTATION OF A MULTI-MISSION TORQUE MODEL SIMULATOR FOR EARTH SATELLITES

**Abstract**

Satellites in Earth orbits are exposed to a variety of environmental disturbances that affect their attitude over time. Accurate analyses and simulations of the effect of each perturbation on the dynamics of a satellite constitute a very important process in the design of active and passive attitude controllers. The accuracy of the analysis depends on several factors including the geometrical model of the satellite and any assumptions and approximations in the description of the environmental torques. Multiple commercial mission analysis tools exist that simulate the attitude of the satellite over time. However, the cost of such tools might not be justifiable for small satellite projects developed in schools and universities. On the other hand, open-source torque simulator tools are often limited in scope and capabilities. For example, some models are designed for a specific satellite geometry and others neglect some disturbances. This project aims to provide an open-source, freeware tool capable of simulating the effect of all relevant disturbances on the attitude for any satellite geometry and to do so with minimum computational cost and at the accuracy level specified by the user. A discretized model for the satellite geometry and mass distribution is adopted. This ensures a higher accuracy than rigid-body models. The tool provides variety of outputs including the evolution of the integrated Euler angles and the angular rates of the satellite over time. One of the objectives behind the project is to use this innovative tool in a real satellite mission analysis. Yahsat Space Lab team at Khalifa University is in the stage of developing a 6U CubeSat. Therefore, this tool will be very useful for the torques analysis and attitude control design of the CubeSat project.