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ACCURACY COMPARISON AND ERROR SOURCES OF DIFFERENT ATMOSPHERIC DENSITY MODELS

Abstract

In order to design the attitude control system for a LEO satellite as accurate as possible, for the purpose of orbit determination and orbit propagation, being able to simulate the space environment is very important. For launch vehicles, ballistic missiles, and low Earth orbit satellites one of the most significant disturbance torques is aerodynamic torque. This torque is not easy to compute, due to the atmospheric density which varies significantly with solar activity. There are different models available from different organizations to estimate the atmospheric density by different methods. Some of these models include 1976 U.S. Standard Atmosphere, Atmospheric Handbook, Harris-Priester, Jacchia 1960, 1970 and 1971, Jacchia- Roberts, CIRA 1961, 1972 and 1986, MSIS models, MET model. There are some papers available which have studied and compared a few of these models with each other such as Keith A. Akins which has done a comparison between MSIS and Jacchia models in 2003; Picone that has studied NRLMSIS-00 in details; Miller who has studied the errors of density models; and also Young in 2001 has published a paper on using GPS data to determine the density in LEO but there isn't any further comparison between this results and using the models. Nonetheless all the sources available on this matter are not updated while the models become updated every 5 10 years, also all these works have not adequately addressed the comparison issue as in there is no paper available that covers more than 3 of the models being compared with each other. This paper addresses this issue by comparing the result of different models on different altitude of orbits and also tries to find the source of these differences. The general idea accepted by most of the researchers is that the latest developed model is necessarily the most accurate one. But it has never been scientifically acknowledged whether this conclusion is true or not. In conclusion, this paper, by closely examining different atmospheric models, tries to shed new light on the neglected issue of the accuracy of the models and will try to make it clear to the users and researchers that which model is the most suitable one for which altitude and for which purpose (orbit determination, in-orbit calculations, etc.) by the current year.