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# AUTONOMOUS SPACECRAFT ATTITUDE CONSTRAINTS AVOIDANCE

**Abstract**

Spacecraft attitude control systems often have angular constraints that stems from the use of limited field of view sensors and from the need to protect on-board equipment from space hazards. Such hazards could be for example:

- Exposure of optical payload to the sun radiation may cause temporal damage to the optics
- Continuous exposure of optical payload to atomic oxygen may cause permanent performance degradation to the payload
- Exposure of a star tracker to the sun radiation or to earth albedo in the field of view may cause loss of tracking ability and thus degraded attitude performance of the spacecraft
- Angular limited sensors e.g. sun-sensors and earth sensors must keep the sun and earth respectively in their field of view in order to maintain the capability of sensing the attitude

Traditional attitude determination and control systems do not incorporate on-board autonomous attitude trajectory planning system that is capable of avoiding such hazards. Instead every scenario is checked in a ground based simulation prior to uploading commands to the spacecraft. In case an attitude violation occurs in space despite previously checked in a ground simulation, the spacecraft mode of operation is switched to safe-mode in order to protect the on-board equipment. In this paper a novel autonomous on-board method for handling attitude violations is suggested. An analytical closed-form solution is developed for single or multiple angular constraints missions. The analytical solution takes the form of a controller that commands angular velocity. Global and asymptotic stability is proved and thus convergence of the analytical solution is guaranteed for any type of constraint given that a legal trajectory between the initial and the final conditions exists. The analytical solution computational requirements are suitable for implementation in a modern spacecraft computer.