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TANSAT POINTING STRATEGY AND ATTITUDE GUIDANCE LAW

Abstract

TanSat is the first Chinese space-based atmospheric carbon dioxide (CO2) observation mission. Similarly with GOSAT, OCO and CarbonSat mission, the scientific objectives of TanSat is to improve our understanding on the climate change through monitoring the change of column-averaged CO2 dry air mole fraction, XCO2. The mission is funded by Ministry of Science and Technology (MOST), with CAS (Chinese Academy of Sciences) in charge of both instrument and platform development. The TanSat satellite is expected to be launched in 2015. Unlike normal earth observation satellites, the pointing strategy of TanSat is quite complex to satisfy multiple observation modes of the mission, such as nadir, sun glint, target gazing, sun or moon pointed calibration. Moreover, since the Solar Array Drive Mechanism (SADM) is not adopted in the low-cost platform design, there is strong demand on platform agility: the satellite needs to perform large angle slew each orbit to maintain power. Also the satellite pointing shall respect some special observation constraints, such as principle plane tracking during observation, and no direct sunlight for one instrument with the other observing the Sun for calibration. Pointing strategy has to take into account different constraints to ensure the appropriate orientation of different parts of the satellites during maneuver or each scientific observation mode. The purpose of this paper is to give an overview of the pointing strategy and attitude guidance law which will be implemented in TanSat mission. Considering the complicated pointing strategy, limited computing capability and uplink constraints (4 kbps), the pointing programming and attitude guidance algorithm is essential for the TanSat mission. All attitude data are pre-calculated on ground firstly. For the complicated attitude profile during particular scenario (such as sun-glint, target gazing and constrained maneuver), attitude data are sampled and uploaded as telecommands. A specific guidance algorithm onboard will then restore instantaneous target quaternion and absolute rate based on the data received, while other nominal attitude is generated on board automatically. The attitude coming from both ways are finally merged before being sent to attitude control module for execution. In this way the target attitude is calculated as accurate as possible while minimizing the uplink requirements. Several guidance algorithms are compared in the paper. Simula-

tion results show the algorithm performance in terms of complexity, attitude accuracy, and telecommand compactness.