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Author: Mr. Kevin Bianchi
Thales Alenia Space Italia (TAS-I), Italy

Ms. Eleonora Mariotti
Thales Alenia Space Italia (TAS-I), Italy
Mr. Marco Anania
Thales Alenia Space Italia, Italy

H-INFINITY CONTROLLER DESIGN AND HIL VALIDATION APPROACH FOR HIGH AGILITY SATELLITES WITH FLEXIBLE APPENDAGES

Abstract

The request of high resolution satellite images, linked to the reduction of the revisit time, is leading to the redefinition of the standard in attitude control. In this scenario the agility request, in terms of the ability to quickly change the satellite attitude, is one of the driving feature of the attitude control system. In order to maximize the operability of the satellite, the AOCS shall minimize the time needed to reach the requested attitude pointing performance after an attitude slew manoeuvre. This constraint is more demanding the more the satellite is equipped with flexible appendages, due to the disturbances introduced by the coupling with the AOCS controller. The goal of this study is to present the results of the design and test phase of an high performance attitude controller, based on H infinity control theory, requiring short attitude stabilization time with desired tracking and robustness performance for a satellite with flexible appendages. Moreover this study presents the results obtained during the controller performance test campaign. The final verification has been carried on using real time avionic software-hardware in the Loop bench equipped with flight hardware. The driver of the design phase, presented in this paper, is to assure the desired Robustness and Tracking performances, in particular taking into account implementation constraints imposed by on board processing resources. For those reasons, state reduction and discretization topics are covered in this study. The validation phase has been performed using two different simulation layers: the first one is an high fidelity numerical simulator which is developed to support the controller stability and performance analysis in a preliminary design phase. The second layer is a real time closed loop environment, running the AOC algorithms on the on board computer, integrated with flight AOCS sensors and actuators units.