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FUZZY LOGIC ATTITUDE CONTROLLER IMPLEMENTATION ON BOARD OPS-SAT

Abstract

A correct performance of the Attitude Determination and Control Subsystem (ADCS) is crucial for many space missions. This is why spacecraft manufacturers tend to use well-proved control algorithms like PID or LQR instead of new, less conventional methods based on artificial intelligence like Fuzzy Logic. OPS-SAT, an ESA satellite designed to demonstrate the improvements in mission control capabilities derived from the use of more powerful on-board computers, is a very suitable platform to test in orbit such new algorithms. The reason is its design, which allows experimenters to use, among others, one of the two (redundant) on board ADCS, i.e. to take the control of the satellite attitude, without compromising its safety. This paper describes the work done to implement a fuzzy logic attitude controller as an experiment to be tested on board OPS-SAT, making use of the software framework embedded in it. The result is a highly configurable controller wrapped in a java app compatible with this framework. The way the fuzzy attitude controller has been implemented allows to change the number of terms and membership functions, the type and parameters of each function, the defuzzification method, the definition of the logic operators, the activation and accumulation methods, the number of rules and the content of each rule with only one telecommand with four arguments. It also provides a way to automatize via scripting the commanded desired attitude of the satellite with respect to a determined reference frame. In our case, this will be used to be able to perform the on orbit tests during loss-of-signal periods.