Choice of magnetic attitude control system for nanosatellites

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Abstract: The first Russian technological nanosatellite TNS-O successfully launched from the International Space Station in March, 2005 was equipped with the passive magnetic ACS and a simple attitude determination system. Now the bus of TNS-O is being considered as a universal platform to carry out a set of technological experiments within short missions and also for education of students. Attitude requirements for the bus dictate main features to be taken into account. The first feature is the satellite should be oriented in a given attitude with certain accuracy and time-response. The second feature comprises low cost and low energy consumption, usage of conventional sensors and actuators and autonomous activity. Aggregate of the requirements gives a case to choose a magnetic attitude control system (MACS) as a reasonable candidate. For a satellite with a light requirement for attitude like to avoid a chaotic rotation or to track geomagnetic field vector of intensity a passive MACS is chosen. The hardest requirement concerns initial attitude motion and arrangement of ACS's elements. In order to increase a time-response a combination of passive and active magnetic elements can be utilized. Inestimable advantage of the required orientation towards the Sun and along the local geomagnetic field vector of intensity is that needed attitude determination system can use Sunsensor or three-axis magnetometer only with elementary algorithm of control. For attitude modes which are untypical for MACS responsibility like orientation along the local vertical, towards the Sun or for tracking a given curve-trace on the Earth surface by the satellite axis, nevertheless, active MACS can be used too. We consider attitude dynamics of a satellite with versions of MACS. To choose a proper algorithm we use results of attitude simulation obtained by asymptotical and numerical methods, at our miniature laboratory facility and in flight testing. The combination of these approaches is presented. Copyright IAF/IAA. All rights reserved.

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