AOCS Hardware for Autonomy

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Slide Draft content 1 AOCS Hardware for Autonomy 2 Introduction • SSC's background: Odin, SMART-1 • Ongoing projects: PRISMA, SGEO, PROBA-3, SMART-OLEV • Our vision: autonomous science and EO missions 3 Autonomy is a driver for hardware development • Attitude and rate estimation • Safe mode sensors • GEO sensors • Formation flying sensors • Actuators 4 Attitude and rate estimation • APS based Star sensors • Low class gyros, i.e. rate sensors • Of course, mission dependent 5 Star tracker trend • Only star sensor, i.e. no gyros • Autonomous (lost in space solution within 1 second) • Robust (to solar storms) • Reliable, i.e. proof of no drop-outs • Few field-of-view limitations: all sky operation (stars between 7 and 12), moon in FoV 6 Star tracker characteristics • Accuracy < TBD , i.e. not a driver for many missions • Rate tolerance > TBD • Acceleration tolerance > TBD , e.g. for usage during kick motor firing 7 Gyro/rate sensor trend • Only for failure detection for many missions • Robust • Reliable • Not necessarily accurate • Miniaturization • Built-in FDIR 8 Gyro/rate sensor characteristics • Fault tolerant, fault tolerant, fault tolerant! • Accuracy requirement not a driver • Desirable characteristic: long term bias stability • No European equivalent to Systron-Donner's QRS-11 9 Safe mode sensors • Fault tolerant • Complementary to autonomy 10 Sun sensor system • System of single orthogonal cells • No blind spots, i.e. 4ð steradian coverage (blind spot implies failure) (albedo tolerant) (eclipse detection) • Low accuracy 11 Sun sensor example 12 GEO sensors 13 GPS in GEO • Onboard orbit determination in presence of thrusting • Simplify collocation • Reduce cost 14 Earth sensors • Traditional earth sensors will eventually be replaced by star trackers + orbit determination which gives higher accuracy • APS based • Degraded earth pointing in safe mode • Orbit determination 15 Formation flying sensors 16 Relative GPS • OTS in near future 17 Rendezvous camera: far range to close range to docking 18 Actuators 19 Electric propulsion • Power Processing Unit: more development needed, easier switching between thrusters • Promising development: HEMP-T 20 Microthrusters • Linear to zero 21 Onboard processor capacity and scalability • Onboard orbit determination and propagation • Formation keeping (increased processing with formation size) 22 Summary and conclusion