

AN EXAMPLE OF HIGH PROCESSING POWER PAYLOAD COMPUTER: THE GAIA VIDEO PROCESSING UNIT

Soucaille, J.F.¹; Paulet, P.¹; Lloyd, C.¹; Bennie, P.¹; Paulsen, T.²

¹Astrium Satellites; ²ESA/ESTEC

GAIA is an ambitious mission of the European Space Agency (ESA) whose spacecraft is developed by EADS Astrium. Its objective is to create the largest and most precise three-dimensional map of our Galaxy by providing unprecedented positional and radial velocity measurements for about one billion stars in our Galaxy. The Gaia payload module consists of two telescopes imaging the sky onto a very large Focal Plane Assembly (FPA) consisting of seven parallel rows of up to seventeen 10 Mpixel CCDs, extracting the relevant star positional, velocity and photometric information.

For each focal plane row, a Video Processing Unit (VPU) is in charge to request and acquire the raw CCD data (video samples) from the FPA, identify objects of scientific interest (stars or solar system objects), track and record these objects during their transit through the FPA. The VPU then assembles the data corresponding to a given object in a telemetry star packet and transmit the packet to the payload mass memory for storage and downlink.

Each VPU executes video and compression algorithms in order to reduce the amount of telemetry data. The real-time part of the algorithms is implemented in hardware for ensuring a good interface with the FPA electronics; for flexibility purpose, a significant part of the algorithms is implemented in software. The VPU architecture is therefore a computer with two boards: one CPU board running the software and one companion board in charge of the hardware part of the algorithms. When dense areas of the sky are observed, the software algorithms require a processing performance higher than 1000 MIPS. No qualified European source was found for the CPU board, meeting the requirements for high processing performance together with radiation tolerance and development maturity. The SCS-750 board from the US Company Maxwell Inc, consisting of three PowerPC processors and a hardened voting function, has been selected for fulfilling the Gaia needs. The SCS-750 PowerPC board from the US Company Maxwell Inc was kindly made available for prototyping the Gaia video algorithm, allowing the demonstration of performances, and is in the process of being space qualified,. Besides the CPU board, the companion board is under development implementing the necessary PCI, SpaceWire and other specific interfaces thanks to the use of two radiation tolerant FPGAs.

This presentation will outline the Gaia processing requirements, the selected architectural solution, and recommendations for similar future missions.