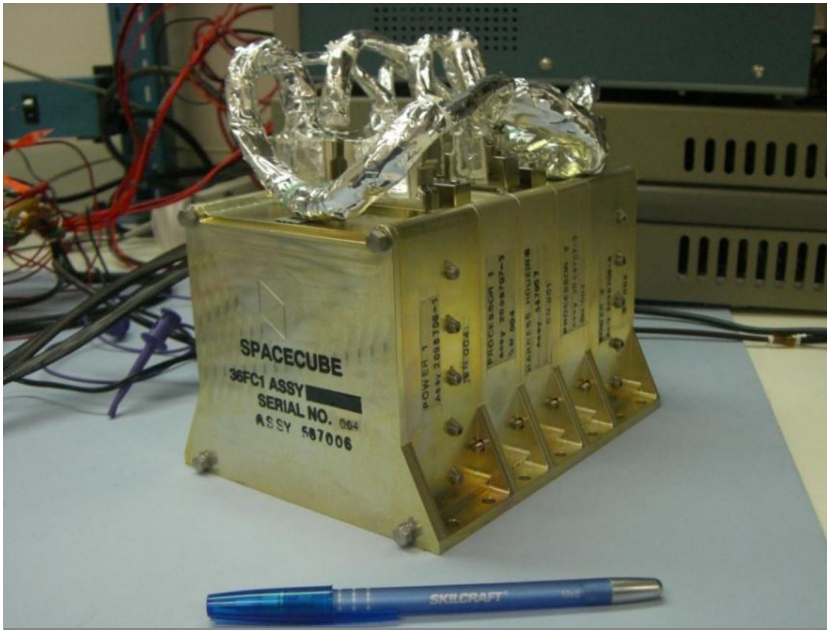




TECHNOLOGY SOLUTION

Electrical and Electronics



SpaceCube

A Family of Reconfigurable Hybrid On-Board Science Data Processors

SpaceCube is a cross-cutting, in-flight reconfigurable Field Programmable Gate Array (FPGA) based on-board hybrid science data processing system developed at the NASA Goddard Space Flight Center (GSFC). The goal of the SpaceCube program is to provide 10x to 100x improvements in on-board computing power while lowering relative power consumption and cost. The SpaceCube design strategy incorporates commercial radiation-tolerant Xilinx Virtex FPGA technology and couples it with an integrated upset detection and correction architecture to provide reliable order of magnitude improvements in computing power over traditional fully radiation-hardened flight systems.

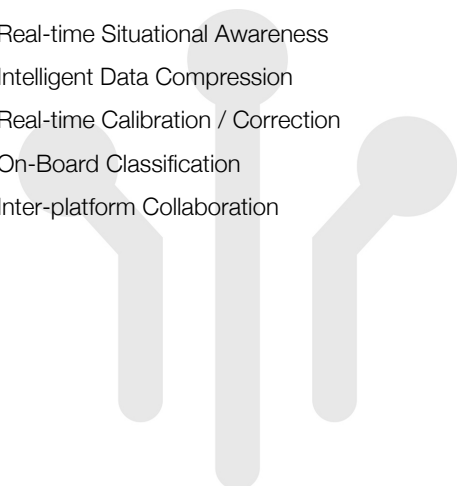
BENEFITS

- 10x to 100x more on-board computing power than current radiation-hardened space processors
- Efficient and low cost: SpaceCube allows for relative power consumption and cost to be dramatically lowered in comparison with alternatives

APPLICATIONS

The technology has several potential applications:

- Real-time SAR / Lidar / Image Processing
- Autonomous Operations / Robotic Servicing
- On-Board Product Generation
- Real-time Event / Feature Detection
- Real-time Wavefront Sensing and Control
- On-Board Data Volume Reduction
- Real-time Situational Awareness
- Intelligent Data Compression
- Real-time Calibration / Correction
- On-Board Classification
- Inter-platform Collaboration



THE TECHNOLOGY

Next generation instruments are capable of producing data at rates of 108 to 1011 bits per second, and both their instrument designs and mission operations concepts are severely constrained by data rate/volume. SpaceCube is an enabling technology for these next generation missions.

SpaceCube has demonstrated enabling capabilities in Earth Science, Planetary, Satellite Servicing, Astrophysics and Heliophysics prototype applications such as on-board product generation, intelligent data volume reduction, autonomous docking/landing, direct broadcast products, and data driven processing with the ability to autonomously detect and react to events. SpaceCube systems are currently being developed and proposed for platforms from small CubeSats to larger scale experiments on the ISS and standalone free-flyer missions, and are an ideal fit for cost constrained next generation applications due to the tremendous flexibility (both functional and interface compatibility) provided by the SpaceCube system.

Unit	Mission	Notes	Specs	Stats
SpaceCube 1.0a	Hubble Servicing Mission 4	Relative Navigation Sensors Experiment STS-125 May 2009	4"x4" card (2) Virtex4	Size: 5"x5"x7" Wt: 7.5 lbs Pwr: 37W
SpaceCube 1.0b	MISSE-7 (ISS)	added RS-485, RHBS, STS-129 Nov 2009	4"x4" card (2) Virtex4	Size: 5"x5"x7" Wt: 7.5 lbs Pwr: 32W
SpaceCube 1.0c	DEXTRE Pointing Package (ISS)	Original RNS unit, w/added 1553 & Ethernet	4"x4" card (2) Virtex4	Size: 5"x5"x7" Wt: 7.5 lbs Pwr: 40W
SpaceCube 1.5	SMART (DoD/ORS)	adds GigE & SATA, commercial parts, sounding rocket flight	4"x4" card (1) Virtex5	Size: 5"x5"x4" Wt: 4 lbs Pwr: < 20W
SpaceCube 2.0	Earth/Space Science Exploration missions	Std 3U form factor, GigE, SATA, Spacewire, cPCI	4"x6" card (2) Virtex5 (1) SIRF	Size: 5"x5"x7" Wt: < 10 lbs Pwr: 20-40W
SpaceCube 2.0 Mini	CubeSats, Sounding Rocket, UAV	"Mini" version of SpaceCube 2.0, CubeSat form factor	2.5"x2.5" card (1) Virtex5/SIRF	Size: 3.5"x3.5"x3.5" Wt: 3 lbs Pwr: <10W

SpaceCube Family Overview

	MIPS	Power	MIPS/W
MIL-STD-1750A	3	15W	0.2
RAD6000	35	10-20W	2.33 ¹
RAD750	300	10-20W	20 ²
SPARC V8	86	1W ³	86 ³
LEON 3FT	60	3-5W ³	15 ³
GSFC SpaceCube 1.0	3000	5-15W	400 ⁴
GSFC SpaceCube 2.0	5000	10-20W	500 ⁵

Processor Comparison

PUBLICATIONS

Patent No: 9705320; 9549467; 9851763

Patent Pending

More Information

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GSC-16673-1, GSC-16700-1, GSC-16805-1, GSC-16808-1, GSC-TOPS-35