



NASA SBIR 2011 Phase I Solicitation

03.05 Advanced Motion Imaging

Lead Center: MSFC

Participating Center(s): JSC

Digital motion imaging technologies provide great improvements over analog systems, but also present significant challenges. Digital High Definition Television (HDTV) cameras flown on the Shuttle and International Space Station have shown higher susceptibility to ionizing radiation damage, manifested by visible "dead" pixels in the image. In order to practically deploy HDTV cameras, sensors and processors need to survive operations on orbit for years without debilitating radiation damage that degrades image quality and performance.

The focus of this subtopic is the development of components, systems, and core technologies that advance the capabilities to capture, process and distribute high-resolution digital motion imagery without performance degradation from ionizing radiation that would require frequent upmass to orbit to replace components or systems.

Current State of the Art

HDTV cameras flown on the Space Shuttle and the International Space Station have proven to be highly susceptible to damage from ionizing radiation. This damage is manifested by bad pixels that eventually render the camera useless after short periods of on-orbit use, usually less than one year. In addition, upmass and downmass constraints make the use of large format motion picture film cameras impractical, so a digital equivalent is needed for large venue documentary film productions, such as IMAX films.

Domains of Interest

Domains of interest in the near term address needs for space environment, radiation tolerant, HDTV and digital cinema cameras and down-stream video processors. Mid and Long term goals include radiation tolerant, reprogrammable, highly bandwidth efficient encoders and improved distribution systems for video data signals. Current HDTV transmissions from the ISS require approximately 25 Mbps. Bitrates with equal or better video quality are desired at half that bit rate. These systems are highly desired by the human spaceflight programs.

Technologies of Interest

Technologies are sought that provide high resolution, progressively scanned motion imagery with limited or mitigated radiation damage to sensors, are viable for astronaut hand-held applications or external spacecraft use, and that provide imagery that meets standards commonly used by digital television or digital cinema production facilities. Commercial HDTV cameras used for internal hand-held use have generally been small and light (5" x 6" x 11", between 2 and 3 pounds), run off rechargeable batteries, and utilize standard lens mounts. Future cameras for exterior applications ideally would be smaller and more modular in design (no larger than 4" x 5" x 7" and 2.5 pounds). The critical technology need is the radiation tolerance of the sensor, not the size, weight and mass of the camera that results from such a sensor.

While commercial HDTV and Digital Cinema cameras for use on Earth are mature technologies, there are no flight-proven radiation tolerant HDTV and Digital Cinema cameras and sensors currently available. Commercial cameras flown on the Shuttle and ISS thus far do function, but degrade within a year on orbit. While hard to classify, the current TRL for these cameras within the context of spaceflight operations could be considered to be a 5 or 6. The ultimate goal is to develop radiation-hardened camera sensors capable of surviving three or more years in space.

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II hardware and software demonstration, and delivering a demonstration unit or software package for NASA testing at the completion of the Phase II contract.

Phase I Deliverables: Deliverables for Phase I will include designs and development plans with plausible data and rationale that demonstrates why the designs and plans should mitigate radiation effects on the sensors, and a detailed path towards Phase II hardware demonstration. The report shall also provide options for commercialization opportunities after Phase II.

Phase II Deliverables: Deliverables for Phase II will include developmental hardware suitable for testing in a lab or space flight environment (TRL 6) as well as a test plan, relevant data, and defined expected lifespan of the sensors.