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An infrared high rate video imager for various space applications

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Modern spacecraft with high data transmission capabilities have opened up the possibility to fly video rate imagers in space. Several fields concerned with observations of transient phenomena can benefit significantly from imaging at video frame rate. Some applications are observations and characterization of bolides/meteors, sprites, lightning, volcanic eruptions, and impacts on airless bodies. Applications can be found both on low and high Earth orbiting spacecraft as well as on planetary and lunar orbiters. The optimum wavelength range varies depending on the application but we will focus here on the near infrared, partly since it allows exploration of a new field and partly because it, in many cases, allows operation both during day and night. Such an instrument has to our knowledge never flown in space so far. The only sensors of a similar kind fly on US defense satellites for monitoring launches of ballistic missiles. The data from these sensors, however, is largely inaccessible to scientists.

We have developed a bread-board version of such an instrument, the SPOSH-IR. The instrument is based on an earlier technology development – SPOSH – a Smart Panoramic Optical Sensor Head, for operation in the visible range, but with the sensor replace by a cooled IR detector and new optics. The instrument is using a Sofradir 320x256 pixel HgCdTe detector array with 30μm pixel size, mounted directly on top of a four stage thermoelectric Peltier cooler. The detector-cooler combination is integrated into an evacuated closed package with a glass window on its front side. The detector has a sensitive range between 0.8 and 2.5 μm. The optical part is a seven lens design with a focal length of 6 mm and a FOV 90deg by 72 deg optimized for use at SWIR. The detector operates at 200K while the optics operates at ambient temperature. The optics and electronics for the bread-board has been designed and built by Jena-Optronik, Jena, Germany. This talk will present the design and the strong and the weak points as found through testing will be identified. Possible alternatives for improvements will be discussed and two flight applications will be outlined.