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reside in a housing and are held in a cube configuration with a cover comprising the fourth side. The RBI calibration using the SCT will be performed directly above the North Pole with a full illumination of a diffuser for about 2.5 min. The large degradation of solar diffuser reflectance presents challenges for calibration accuracy especially in the UV region of the spectrum. The first Spectralon diffuser will be used bi-weekly, the second used – quarterly, and the last one used – yearly – so that one of the diffusers will remain a "pristine" reference diffuser. The design is straightforward and similar to the design used in other space instruments. The ICT is based on the CrIS (Cross-track Infrared Sounder) flight design. It is a calibration source with a well-known emissivity and well-known cavity temperature providing calibrated radiance at different controlled temperatures. The suite of stable on-orbit references will ensure that calibration stability is maintained over the RBI sensor lifetime.

Several VCT designs were studied using ZEMAX-based modeling (considering different integrating sphere and laser diode source options) in which uniformity of the radiation at the focal plane of the RBI telescopes was analysed. We also studied different models of the flight heritage Spectralon to evaluate its degradation in space. Finally, BRDF measurements of witness Spectralon samples, to be used in the future for calculating the diffuser degradation, are presented.

10000-66, Session PS

Software and mathematical support of Kazakhstani star tracker

Daulet Akhmedov, Suleimen Yelubayev, Institute of Space Techniques and Technology (Kazakhstan); Vladimir Ten, NC Kazakhstan Gharysh Sapary (Kazakhstan); Timur Bopeyev, Kuanysh Alipbayev, Anna Sukhenko, Institute of Space Techniques and Technology (Kazakhstan)

Currently the specialists of Kazakhstan have been developing the star tracker that is further planned to use on Kazakhstani satellites of different purposes. At the first stage it has been developed the experimental model of star tracker that has following characteristics: field of view - 20°, update frequency - 2 Hz, exclusion angle - 40°, accuracy of attitude determination of optical axis/around optical axis - 15/50 arcsec.

Software and mathematical support are the most high-technology parts of star tracker. This article is devoted to the development of software and mathematical support of Kazakhstani star tracker experimental model. There are described the main mathematical models and algorithms that have been used as the basis for software of Kazakhstani star tracker, main components of program simulation complex for the testing of star tracker software, results of testing of star tracker software.

Software and mathematical support of Kazakhstani star tracker is based on the algorithms of star identification and attitude determination. Current coordinates of stars determined in result of preliminary processing of starry sky image are used as the input parameters of these algorithms.

Radiometric correction, binarization, filtration, pseudostars localization and centroids determination are the main stages of preliminary processing of Kazakhstani star tracker. Radiometric correction is carried out for the correction of image faults caused by read noise, zero shift and dark current. At the stage of binarization and filtration all excessive information on image are excluded and objects contours are extracted. The image obtained as a result of binarization and filtration is used for connected components labeling or so-called localization of pseudostars for which the determination of centroids is made subsequently.

Star identification is carried out for three pseudostars named as triad into which the brightest star on the image and its nearest neighbors are included. To identify the stars on image it is carried out the search of correspondence between angular distances of triad and angular distances of stars in star catalogue in accordance with the K-vector method.

Attitude determination of Kazakhstani star tracker is conducted on the base of minimization of residual between vectors of identified stars coordinates and vectors of coordinates of corresponding stars in star catalog by using singular decomposition.

For testing of software and mathematical support of Kazakhstani star tracker it has been developed the program simulation complex including starry sky simulator and the block of analysis. Modeling of dynamic change of starry sky taking into account the noise of detectors, distortion of optical system and its point spread function is carried out in the starry sky simulator. The image obtained from the simulator is transmitted through the Ethernet network into software and mathematical support of star tracker launched on evaluation board where the cycle of calculations on attitude determination of star tracker is conducted. The obtained results are processed in the block of analysis where the residual between estimated and true attitude of star tracker is calculated.

For estimation of attitude determination accuracy of the Kazakhstani star tracker under different conditions with the help of developed program simulation complex the testing of software and mathematical support is conducted for various disturbance configurations including detector noises, point spread function modeling and distortion of optical system up to 2%.

In total tests showed good results for algorithms realized in software and mathematical support of Kazakhstani star tracker. Tests for non-ideal point spread function, considering detector noises and distortion of optical system showed the accuracy of attitude determination of optical axis of star tracker not worse than 9.6 arcsec and accuracy of determination of rotation angle around the optical axis of star tracker not worse than 45.5 arcsec.

10000-67, Session PS

A spaceborne visible-NIR hyperspectral imager for coastal phenology

Steven N. Osterman, Johns Hopkins Univ. Applied Physics Lab., LLC (United States); Frank E. Muller-Karger, Univ. of South Florida (United States); David C. Humm, Matthew W. Noble, Shawn M. Begley, Johns Hopkins Univ. Applied Physics Lab., LLC (United States); Christopher B. Hersman, Johns Hopkins Univ Applied Physics Lab LLC (United States); Erin L Hestir, Marien, Earth and Atmospheric Sciences/North Carolina State University (United States); Noam R. Izenberg, Mary R. Keller, William Jeffrey Lees, Johns Hopkins Univ. Applied Physics Lab., LLC (United States); Adam S. Magruder, Nu-Tek Precision Optical Corp. (United States); M. Frank Morgan, Johns Hopkins Univ. Applied Physics Lab, LLC (United States); Helmut Seifert, Johns Hopkins Univ Applied Physics Lab LLC (United States); Kim Strohbehn, Johns Hopkins Univ. Applied Physics Lab., LLC (United States)

The instrument design employs a three mirror off axis Gregorian design for stray light suppression feeding an Offner spectrograph with a 2D visible CMOS array for visible hyperspectral imaging and two InGaAs linear arrays for selected SWIR bands. The instrument employs passive polarization scrambling, careful thermal design and an innovative viewing profile that allows high signal to noise observation of relatively dark aquatic scenes and fixed, repeatable viewing geometry for brighter wetland and terrestrial vegetation scenes. We present optical, mechanical and thermal design details and performance predictions (including spacecraft pointing and jitter and scrambler MTF contributions).