The Mars Exploration Rover Suncam

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NASA will send two identical scientific rovers to different locations on Mars in 2003. The Rovers will each have a mass of ~150 kg and they will operate for up to 90 days on the surface of Mars. During this period of time, they will travel about 1 km. The primary scientific objective of the mission is to obtain knowledge of ancient water and climate on the red planet. The scientific instruments includes a stereo pair of panoramic cameras, and a Microscopic Imager

For navigation purposes and high gain antenna pointing, the rover has additional 7 engineering cameras. All 10 cameras are similar except for the optics. The focal plane of each one is a 1024 x 1024 pixel frame transfer CCD.

One of the engineering cameras, the Suncam, acquires images of the sun and determines the sun vector relative to the rover. This information is used, in combination with an inclinometer to point the high gain antenna at Earth and to provide a reference for the inertial measurement unit that is used for rover navigation.

The Suncam optics have a field of view of 45 x 45 degrees, an f/# of 15 and an ND filter to avoid saturation. Radiometric calculations will be presented that shows that a ND 6.4 filter is required.

A technical description of the detector, optics and electronics of the Suncam will be covered. Also, the robust algorithm that detects the Sun is presented.

The required accuracy of the Suncam is a fraction of a degree. In order to ensure this, an error budget has been constructed. This includes considerations of the read noise, dark current, dark current non-uniformity, dust glow, pixel response homogeneity, CTE and frame transfer smear, ghost images, optical errors, boresight stability and calibration residual.

The mathematical model of the suncam that transforms the centroids into angles is presented. This discussion will include how the parameters for the model are found using observations of the real sun and a precision divider head.

The angular size of the sun is 0.5 degrees at Earth and 0.35 degrees at Mars. The centroiding algorithms can therefore not be tested utilizing normal Earth based observations. Therefore, a special sun observing facility at Table Mountain Observatory is utilized. The coelostat with associated optics will provide a Sun image with Martian characteristics. The facility will be described and the accuracy of the coelostat will be measured.