ON ONE TECHNIQUE FOR DETERMINING THE SPACECRAFT ATTITUDE FROM THE SUN

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Abstract

A variant to implement a spacecraft (SC) spatial attitude system with respect to the Sun is discussed. The sunward direction and the solar rotation axis are used as reference points. The system is based on measuring spectral line Doppler shift by scanning the solar image along the limb and is self-adjusting for relative spectral line shifts and instrument band shifts. The first harmonic of the signal serves as a basis for accurate adjustment of filter band. The second harmonic phase is used to measure the spacecraft attitude. The application of this method holds the greatest promise when the SC is stabilized by the sunward spinning because this ensures continuous monitoring of the spacecraft attitude. In addition, the method provides information on the precise coordinates of solar surface details during space-borne observations.

Key words: orientation in space, solar rotation.

Introduction

The solar rotation-associated component is most clearly revealed in observations of the velocity field spatial distribution on the Sun. This component can be used to identify with confidence the position of the solar rotation axis on the image being analyzed [Beckers 1978, Ivin 1984]. Since the rotation axis position remains unchanged, this can play the role of a compass in circumsolar space, a fact that can be successfully used in space navigation during missions of unmanned interplanetary probes and other spacecraft for their attitude control and to point on-board instruments in the desired direction.

There exists a well-known spacecraft (SC) attitude control technique in which one of the SC coordinate system axes is pointed to the solar disk center and the SC is rotated about this axis until a given reference star enters the field of view of the second astrodetector [Moskalenko 1984]. This is followed by simultaneous tracking of the two objects, to achieve spacecraft attitude control in three-dimensional space. The disadvantage of such a method is that it is necessary to have two telescopic astrodetectors, solar and stellar. The directions of the astrodetectors must exactly correspond to each other because any disagreement can lead to the loss of a reference star failure of attitude control. The difference in brightness of reference objects (the Sun and stars) can be $10^{-7}$; therefore, stellar detectors are more sophisticated, must be protected against spurious illuminations by patches of sunlight on spacecraft structural elements and, finally, there is the danger of "blinding" them. In the case of a disagreement it is also possible that another star can be mistakenly defined as reference. This would result in a