MUNIN Attitude Determination by Image Processing Algorithm

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Nano-satellite MUNIN, scheduled for launch in April, 2000 is equiped by passive magnetic attitude control system. The primary purpose of this project is an Aurora observation and upper atmosphere particles behavior researching. It is passively stabilized satellite and its actual attitude information is essential for true data interpretation of on-board equipment. The method of satellite attitude determination by star constellation image processing algorithm is considered. Besides its accuracy it can give three-axis information by using just a single sensor, an on-board digital CCD–camera. An image gives the position of stars in the focal plane, that is, their coordinates in axes related with MUNIN. Using celestial coordinates of the same stars one enables to calculate the transformation matrix, which is in fact the matrix of actual satellite attitude position. Digital image is processed by a computer in such a way, that all stars are extracted and stored in a list with their position in the focal plane. These stars compose a constellation, which is compared with all possible constellations of a star catalog by special matching algorithm developed under these approaches. It seems at least four stars are necessary to identify an unambiguous attitude position with accuracy of $0.2°$. Whenever the constellation has been positively and definitely identified, the celestial coordinates of two outermost stars can be used for actual three-axis satellite attitude information development. Because of comparably long computation time vectorization and preallocation were used to reduce matching time significantly. This method is especially recommended for inexpensive small satellites.