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Corresponding author: CHOUKROUN Daniel
e-mail of corresponding author: danielch@bgu.ac.il
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Title

Single-Frame Attitude Determination from Low Resolution Earth Imaging

Authors
*Alexander Shiryaev [1], Daniel Choukroun [2]**

** Corresponding author*
[1] Ben Gurion University of the Negev, Beer Sheva, 84105, Israel, Mechanical Eng. dept, ashiryaev47@gmail.com
[2]Ben Gurion University of the Negev, Beer Sheva, 84105, Israel, Mechanical Eng. dept, danielch@bgu.ac.il

Abstract
This work is concerned with the development of a single-frame attitude determination algorithm for LEO satellites using Earth imaging only. The algorithm optimally determines the quaternion of rotation from a batch of lines-of-sight. The lines-of-sight construction relies on features extraction rooted in image registration techniques. Several codes for image registration are used. ENVI has the drawback of requiring a manual selection of seed tie points. MATLAB subroutines are automated and lend themselves to on-board attitude estimation but cannot accommodate less than four tie points. The proposed algorithm exploits several techniques of features extraction and can construct a rotation quaternion with only two tie points. Tests that were performed using real images acquired by the Cubesat BGUSAT in the Short Wave Infra Red (SWIR) spectral domain from an altitude of 600 km with a 600 meter resolution demonstrate the validity of the proposed methodology. The proposed vision-only attitude estimator improves by one order of magnitude the current attitude solution, which is based on Sun and magnetic field sensors.