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Author: Mr. Florian DECONINCK
European Space Agency (ESA/ESTEC), The Netherlands, f.deconinck.supaero@gmail.com

Mr. Vincent Beukelaers
United States, vbeukelaers@gmail.com
Mr. Alberto Guillen Salas
USRA / NASA Ames Research Center, United States, alberto.guillensalas@nasa.gov
Mr. Oriol Tintore
NASA Ames Research Center, United States, oriol.tintoregazulla@nasa.gov
Mr. Jasper Wolfe
United States, jasper.l.wolfe@nasa.gov

A SMARTPHONE BASED STAR TRACKER

Abstract

Promoting space faces the challenge of catching people's interest on subjects that seem far away from their everyday lives. In the last few years multiple projects based on Cubesat development have used ordinary technologies as space system devices. The PhoneSat project developed at NASA ARC aims to promote the use of commercial off the shelf component technologies such as Smartphones for space applications. In the frame of this project, we present here the novel idea of using a Smartphone camera as a star tracker. The basic principle is to develop an application on the Android OS phone which output the satellite attitude in the J2000 frame of reference. The phone's star tracker targets at least 0.5 degree pointing accuracy. This would make it the cheapest commercial star tracker ever built with a sufficient accuracy to be used by the cubesat community.

The current star tracker consists of in-house software developed in MATLAB and the Samsung Galaxy S3's camera. The software uses a Hipparcos-based catalogue of 435 pictures with stars of magnitude up to 4.4 (864 stars). The stars recognition pattern used is the "shortest distance" method as described by [1]. A feasibility study for the use of a Smartphone's camera as a star tracker camera has been carried out on various recently released Smartphones. This analysis shows that the key parameter for the Smartphone camera is an ISO of minimum 1000 allowing the detection of stars with magnitude up to 3.3 in an exposure time lower than 0.1s. This choice still requires a heavy post-processing of the images in order to be used by the algorithm. This would be solved by the use of a correct trade-off between the ISO and the exposure time, as well as additional optical devices such as lenses, which would increase the aperture.

This paper describes the development of the software and the analysis of the key parameters of a Smartphone camera to be used as a star tracker. Three steps are now necessary to finalize the star tracker. First, to add a baffle and lenses to the Smartphone camera. Secondly, to adjust the software's parameters to this new configuration. And finally to create the Android application, which requires the translation of the code from MATLAB to native Java.

References [1] Tjorven Delabie et al., A Highly Robust Lost In Space Algorithm Based On The Shortest Distance Transform, AIAA 2011-6435.