GAIA-GBOT PIPELINE: A PRECISE ASTROMETRIC MEASURING TOOL FOR MOVING CELESTIAL BODIES.

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Framework: The Ground Based Optical Tracking (GBOT) group is a part of the "Data Processing and Analysis Consortium", the large consortium of over 400 scientists from many European countries, charged with the scientific conduction of the Gaia[1] mission by ESA. The GBOT group is in charge of the optical part of the tracking of the Gaia satellite. This optical tracking is necessary to allow the Gaia mission to fully reach its goal in terms of astrometric precision level (primarily to correct for the effects of relativistic aberration and for the precise determination of parallaxes of solar system objects), and which cannot be reached using the standard procedures alone, i.e. by a single ranging and communications station. These observations will be done daily, during the 5 years of the mission, with the use of optical CCD frames taken by a small network of 1-2 m class telescopes located all over the world. The requirements for the accuracy on the satellite position determination, with respect of the stars in the field of view, is 20 mas (corresponding to 150 meters at the distance to Gaia). Note that the full level of accuracy that is required for GBOT can only be reached, once we are able to use the first data from Gaia itself, available about 1.5-2 years after mission start (which is even then much more accurate than anything available today) as a reference catalog, meaning that all observation obtained till then need to be re-reduced.

GBOT Pipeline: For this purpose, and as the high level of astrometric precision required for GBOT is quite unusual for moving objects, we have begun to develop a set of accurate astrometric reduction programs specially adapted for tracking moving objects with the use of CCD detectors written in GNU fortran95. The three main routines are:

•*FindSources*: detects and extracts on a fits-image all sources brighter than a threshold value, and determines their pixel (i.e. *x,y*) positions using one of several fitting techniques, which can be chosen by the user.

•*AstroReduc*: links the stars of a reference catalogue with the sources detected into the fits-images and performs an astrometric plate reduction..

•*TargetFinder*: improves the determination of the target centroid.

The main features of interest of this pipeline are: the possibility to choose in a large set of centroiding algorithms well-adapted to moving objects, some robust estimators for the error of positions and a unique framework for all the parts of the reduction process (especially, the control of the all parameters are gathered in a unique monitor file to avoid the choice of some no-coherent set of parameters between each part of the process). This pipeline has been tested on satellites (as WMAP and Planck) and on asteroids.

The aim of this talk is to present to the ACM community an overview of all the capabilities of these routines for the high precision astrometry of moving celestial bodies and to exchange ideas and advice with specialists of asteroids to improve our pipeline which would be undoubtedly useful for our GBOT project.

Notes :

[1] For more information about the Gaia mission, see http://sci.esa.int/science-e/www/area/index.cfm?fareaid=26