Abstract

The Pi of the Sky experiment was built to study astrophysical phenomena variable on short time scales (days–seconds). The main goal was to search for optical counterparts of Gamma Ray Bursts (GRB), but also for variable stars, novae and optical emissions from Gravitational Wave (GW) sources. Pi of the Sky robotic telescopes are autonomous devices monitoring large fraction of the Sky (each camera observing field of $20^0 \times 20^0$) with time resolution of 1–100 seconds and with range of 12^m–13^m. Dedicated algorithms analyze the collected data in real-time allowing for fast recognition for optical flashes of cosmic origin.

LUIZA was designed as a dedicated framework for efficient processing of astronomical images. Data analysis is divided into small, well-defined steps implemented as the so called processors. The framework allows user to define the processor choice and their execution order, as well as all the required parameters at run time, via a simple steering file. The aperture photometry algorithm (dedicated to star identification and instrumental brightness determination on a CCD image) adopted from the ASAS experiment was implemented in LUIZA by the author of this thesis. Having the possibility to modify processor parameters the algorithm can be used to process data (CCD images) coming also from other telescopes with different exposure times, field of view or range.

The photometry algorithm was used to search for variable stars on Pi of the Sky images. To select variable star candidates a dedicated algorithm based on Multi-Variable Analysis (MVA) methods was prepared. In the first step the algorithm has to recognize the functional dependiences between different parameters describing brightness distributions for signal (variable stars) and background (constant stars) based on the simulated variable star samples. These samples were prepared based on single 10s images, were brightness of constant stars was modified to model variable stars with different shapes of light curves and random period of variability not longer than 3 days. The developed MVA application is trained to recognize variable objects by analyzing shape of their magnitudo distribution. The program is sensitive to both short and long period variable objects.