



Investigations for a High Throughput Astrometric Image Analysis Pipeline



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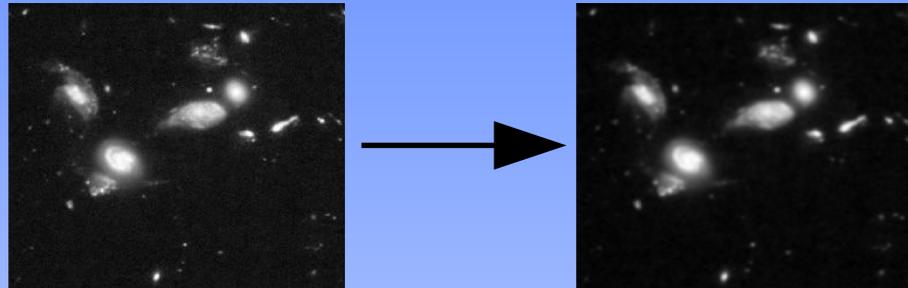
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Abstract: The Large Synoptic Survey Telescope (LSST) is an ambitious 10 year project to build the world's fastest slewing, high throughput, wide-angle camera system. We are investigating novel H/W and software architectures that will allow for the timely processing of LSST's enormous data sets and observing cadence. The Common Pipeline Library (CPL) was investigated as a candidate general-purpose pipeline library and found to be lacking many of the features necessary to satisfy LSST requirements. A profile of DoPHOT, a popular photometric utility for astronomical data, was used to identify computational bottlenecks. These functions will be re-instrumented for parallel processing methods and benchmarked.

Common Pipeline Library (CPL)

A common problem with astrometric pipelines which LSST's designers wish to avoid is a difficult to maintain ad-hoc pipeline development process. Standards need to be investigated and employed to ensure rapid pipeline design, implementation and maintenance. CPL is a standard library used with pipelines for the European Space Organization's (ESO's) Very Large Telescope (VLT). CPL was investigated to determine if it was an appropriate tool for LSST. To enhance our understanding of CPL, a simple linear convolution filter was developed as a CPL-based plugin.



Linear Filtering of a Hubble Deep Field Image

CPL has a rich set of mid-level functions that support development of data reduction algorithms allowing astronomers to focus more on algorithms than on interacting with the library. CPL contains no pipeline support, had poor stability and is not threadsafe. CPL itself was found to be inadequate for LSST, however a library which retains CPL's ease of use and addresses its issues would be an excellent tool.

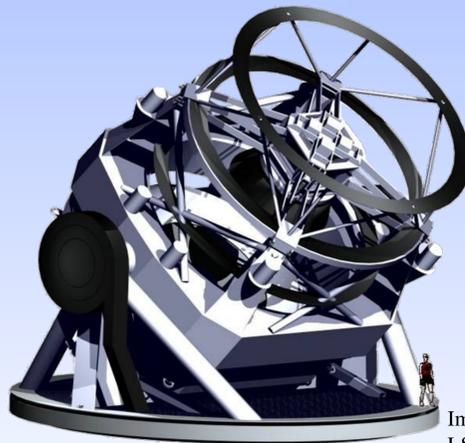
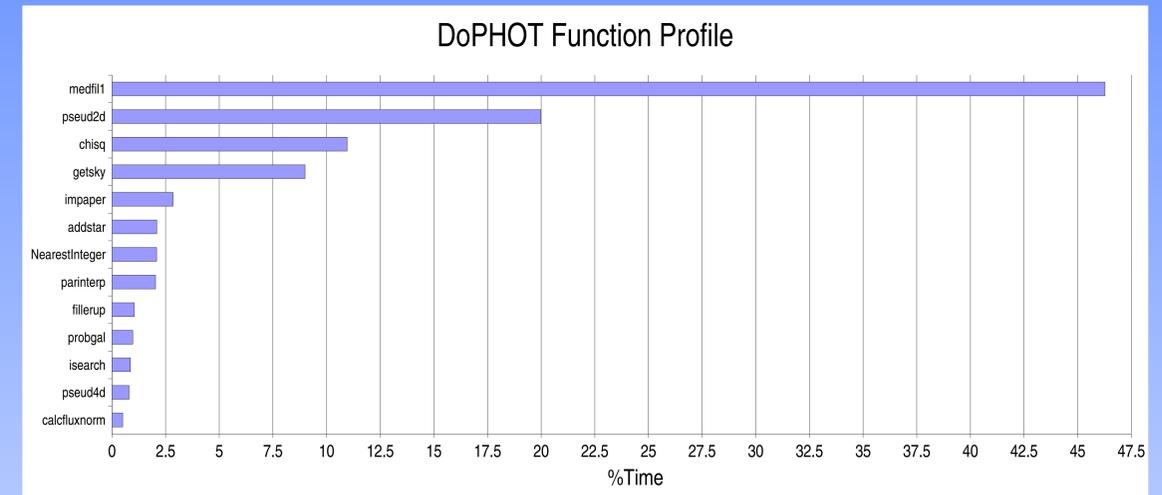


Image Credit: LSST Corporation

Rendering of the 8.4-meter LSST

DoPHOT

LSST requires each 3 gigapixel image to be searched for new objects at a rate matching its observing cadence, approximately one image every 10-15 seconds. Current astrometric software runs substantially longer than this. DoPHOT is a long-running piece of software used in modern pipelines to analyze a digital image of the sky. DoPHOT locates objects and produces position, magnitude and crude classification (star, galaxy, etc) data. A typical DoPHOT run was profiled.



Three functions within DoPHOT account for 77% of the total running time. These functions were examined and their suitability for adaptation to parallel processing was assessed. The "medfil1" function was determined to show the most promise for a parallel implementation.

Still to Come...

- DoPHOT parallel loop re-instrumentation for MPI and ClearSpeed's CS301 Array Processor
- Benchmark against uniprocessor system

