

GTLS: A GPU Algorithm for Speeding up Exoplanet Transit Detection

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Abstract

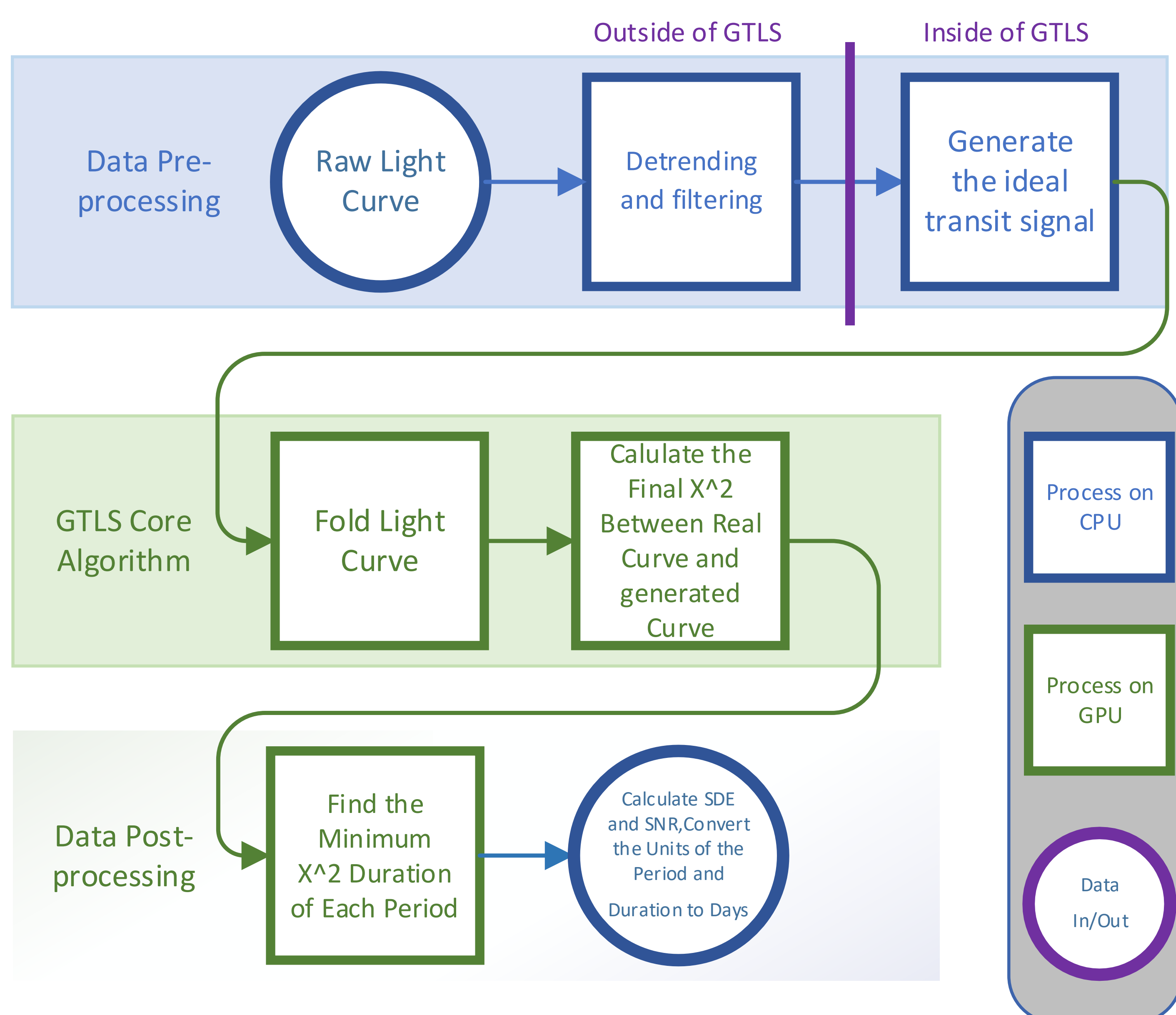
Analyzing transit is a common method to search for exoplanet. Specialized satellites such as Kepler, TESS, etc. generate large amounts of light-change curve data, and higher speed analysis methods are important.

BLS (Box least squares)[1] and TLS (Transit Least squares)[2] are the most common algorithms to find transit signals on light curves.

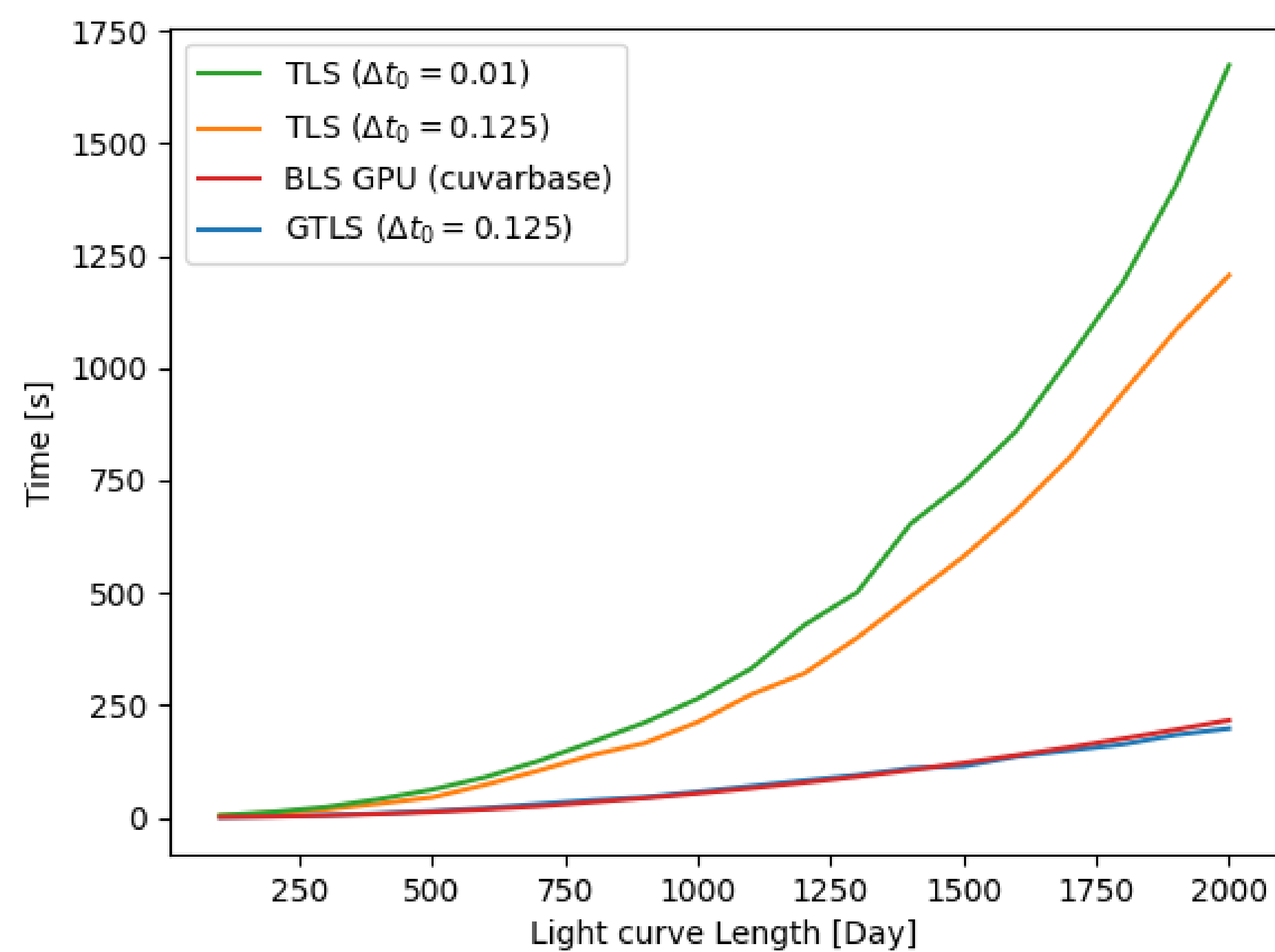
TLS is proved to be a more accuracy way than BLS.[3] But TLS is much slower than BLS on the GPU provided by cuvarbase.[4]

This work provides a way to accelerate TLS using GPU.

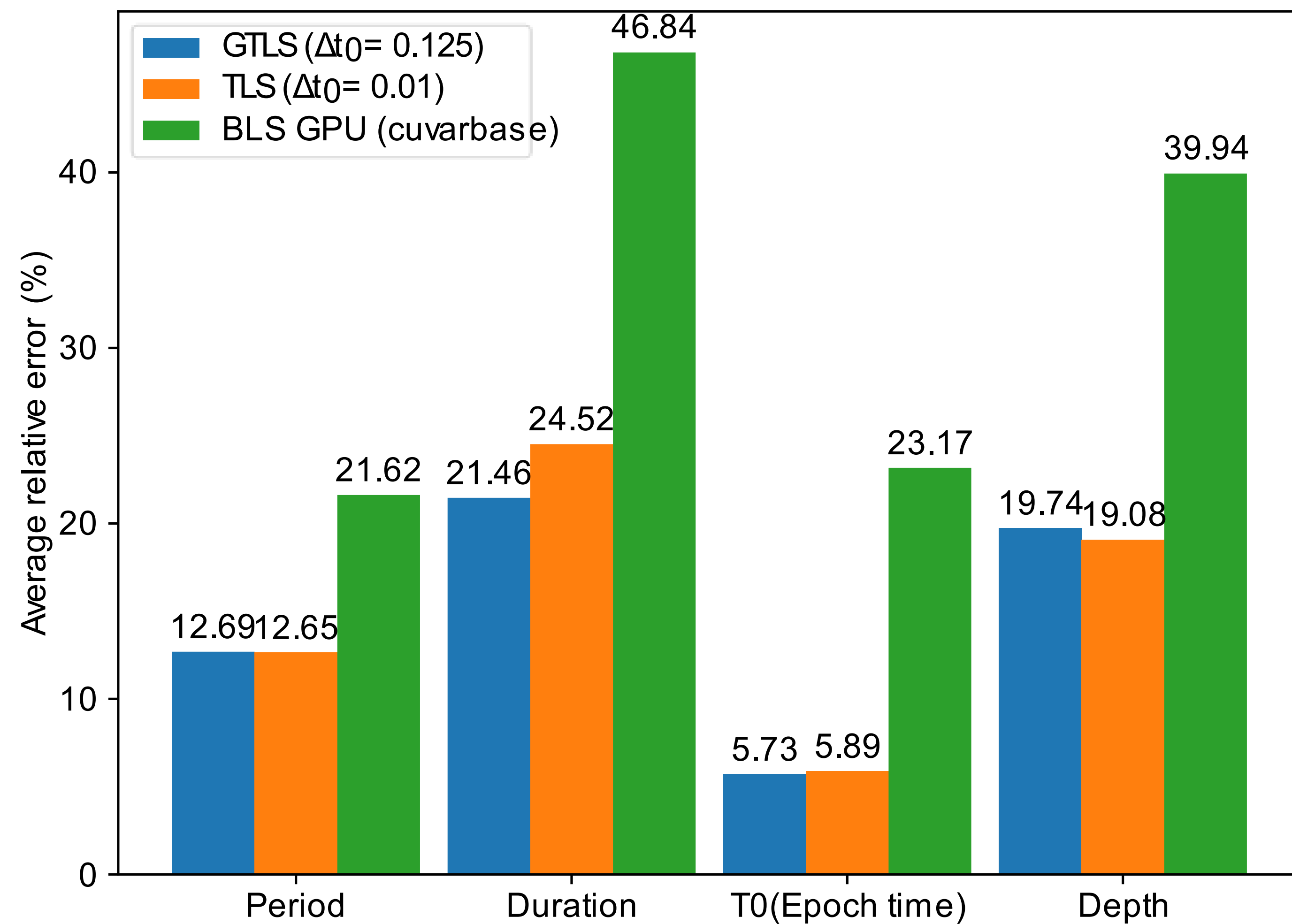
We use Python programming language to implement the CPU part and use CuPy package on Python and CUDA framework to implement the GPU part. The GPU runs the most complex process of this algorithm.



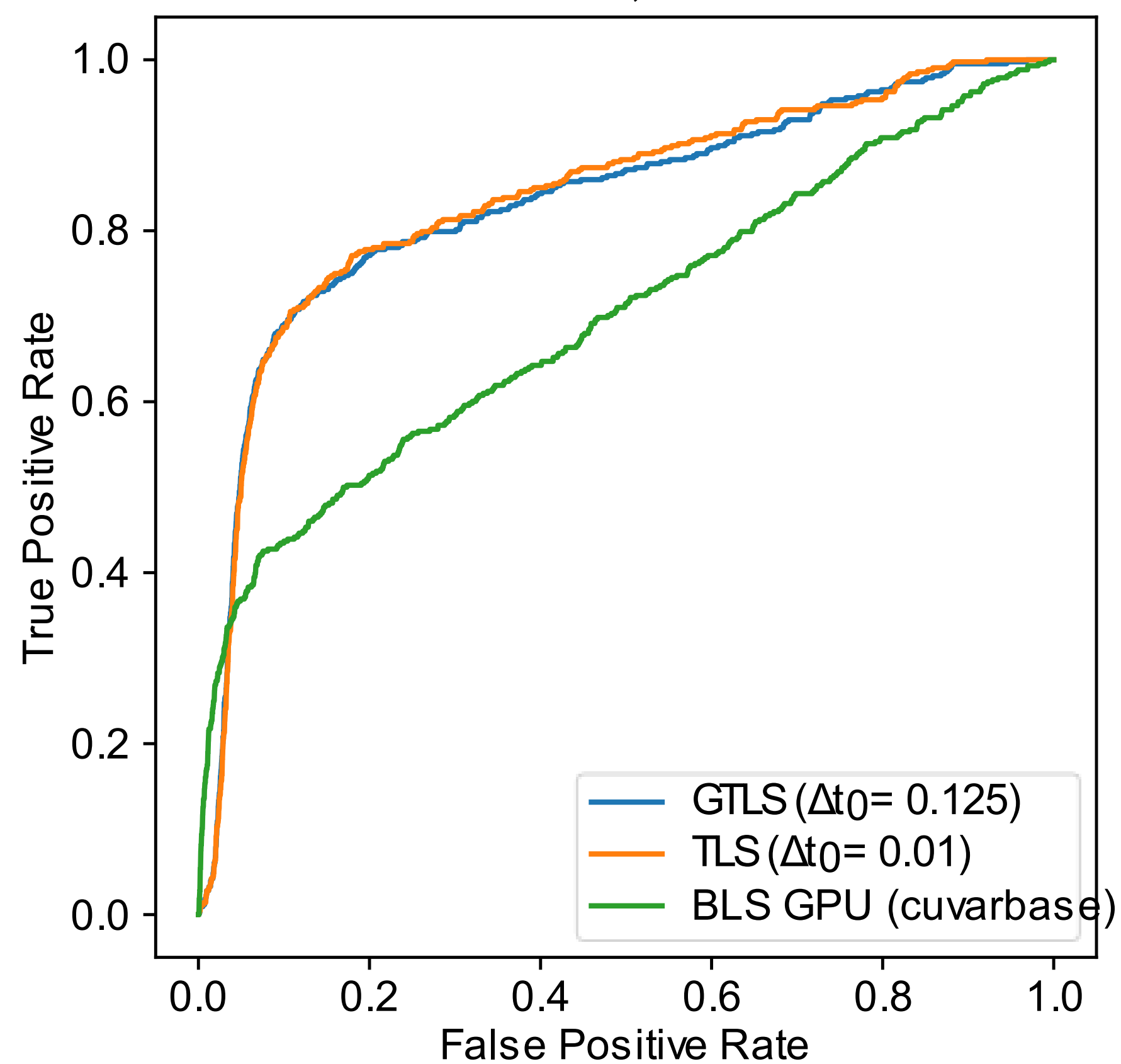
The Speed



Different method test on TESS sector 58



ROC curves based on SDE, test on TESS SECTOR 58



Reference

- [1]Kovács, G. / Zucker, S. / Mazeh, T. A&A A box-fitting algorithm in the search for periodic transits 2002-07
- [2]Hippke, Michael / Heller, René A&A Optimized transit detection algorithm to search for periodic transits of small planets 2019-02
- [3]Canocchi, G. / Malavolta, L. / Pagano, I. / Barragán, O. / Piotto, G. / Aigrain, S. / Desidera, S. / Grziwa, S. / Cabrera, J. / Rauer, H. Discovering planets with PLATO: Comparison of algorithms for stellar activity filtering 2023-04
- [4]Hoffman J., 2017, cuvarbase, <https://johnh2o2.github.io/cuvarbase/>

Acknowledgments

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Test Hardware:

TLS on CPU: Ryzen R9 7950X

GTLS on GPU: RTX4090