Utilizing High Performance Computing to Implement a Compressed Sensing Algorithm to Better Analyze Exoplanet Data

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Exoplanets have garnered interest in the scientific community, as indicated with the launch of TESS and Kepler Telescope's expansive online library of exoplanet data. With the future launch of the James Webb telescope, which uses the transit method to detect exoplanets, it is evident that the field of exoplanet detection will get much information that requires processing from raw data to parameters. This research aims to implement compressed sensing, a method that uses L1 norms in order to reconstruct signals from sparse data sets, to interpret data more efficiently and accurately. L1 norms are implemented into the algorithm because they produce the sparsest possible solution to any linear equation system. Using compressed sensing algorithms on curves has produced robust and sparse results in previous research, prompting to hypothesize that if the algorithm were to be used on transit data, it can distinguish parameters in the same concise manner. 200 exoplanet-cases are generated to test the algorithm and the control's ability to analyze and quantify the planets in the compound transit graph. Results show that compressed sensing algorithm accurately analyzed the data, while the control produced an invalid result. The experiments continued in two tracks: large data and NASA archive data. In the first track, the algorithm was implemented in Shaheen 2, a HPC, on a generated dataset with 50000 exoplanet-curves. The second track tested the algorithm on 2000 exoplanet curves from NASA's Exoplanet Archive. This research contributes toward a better understanding of exoplanet detection methods using compressed sensing.

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