Abstract

In the last twenty years, a large number of planets have been discovered orbiting other stars. The transit method is a popular technique used to detect these planets. Generally the planet cannot be observed separate from the star, and so the light from both objects is combined together. As a planet orbits around its star, the amount of light that we observe from the combined system changes depending on the position of the planet. For instance, when the planet passes in front of the star, it will block some of the star's light, causing a dimming. When we measure this change in flux over time, it forms a light curve. This project focuses on finding the optimum estimations of the physical parameters of a system.

Levenberg-Marquardt algorithm is a technique used to solve nonlinear least squares problems. Many programs developed to analyze and fit parameters determining the light curve models of extrasolar planet systems use the Levenberg-Marquardt algorithm. However, this technique is not foolproof. It often faces issues in reaching the solution for some systems as it is highly dependent on the initial estimates of the parameters, the measurement noise and algorithmic parameters. It also has the tendency to converge to a local minimum and gets trapped in it if there are multiple local minima present.

Therefore, in this project, we investigated various alternative global optimization algorithms, in search of a technique that is able to outperform and replace the Levenberg-Marquardt algorithm in our analysis of light curve models. Our results have shown that the Levenberg-Marquardt algorithm is still the best in terms of the efficiency and the parameters obtained are close to those from NASA Exoplanet Archive and Dr Budding's analysis. Generalized Simulated Annealing is also observed to perform reasonably well and it might be a good substitute.