27th Compact Hierarchical Trinary System Discovered Using Machine Learning

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While binary systems are discovered often in the search for exoplanets, trinary systems are much less researched. Adding more samples to this underreported category has significant implications to better understand their formation and evolution, to study Lidov-Kozai mechanisms and non-Keplerian physical dynamics, and the evolution of life. In this work, I presented the discovery of a new compact hierarchical trinary system using a deep learning model and novel GPU fast folding techniques. A convolutional neural network was trained on synthesized transit data and software was developed to analyze Kepler lightcurves for special traits. This methodology successfully identified a new trinary system in the Kepler dataset KOI 1076. The candidacy is confirmed by using the well known Eclipse Timing Variation (ETV) analysis and a comparative study to the existing trinary dataset. By generating light curve fits and plotting time vs. transit variations, as well as the orbital plane inclinations, this work shows the discovery is a new trinary system. In order to determine if the results are statistically significant, I compare my results of KOI 1076 to the 26 known compact hierarchical systems. It shows that all parameters derived in this system are within the range of the statistical results of Borkovits's 26 systems, specifically the three in retrograde. This makes my discovery the 27th compact hierarchical trinary system, and the fourth in retrograde. This work is among the first to report the discovery of a new trinary system using machine learning with GPU fast folding in the Kepler dataset.

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