Automated Photometric Detection of Uncatalogued Eclipsing Binary Star Systems via Ellipsoidal Variation Amplitude Flagging

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Most traditional detection pipelines miss eclipsing binary (EB) stars because they look for transit-like dips and disregard signals that occur between eclipses, dismissing them as noise. This project's pipeline adds Ellipsoidal Variation (EV), the light curve change from stars being stretched by each other's gravity in close binaries. This project's pipeline (for the detection of EB stars) uses a multi-flag scoring system that collects data from both TESS photometry and Gaia DR3. There is also the usage of a Box Least Squares (BLS) algorithm search to find the period, and then a Fourier fit on the out-of-eclipse (OOE) sections to measure the EV amplitude. The value in using EV amplitude is that orbital inclination is irrelevant, so EB systems can be detected no matter the viewing angle. The approach of using EV for finding EB systems led to the discovery of 40 previously uncatalogued EB systems. We sent them all to the AAVSO VSX, and every single one got approved as an EB system. In a large number of systems, the EV sub-score actually carried the most weight for the final classification, alongside the primary and secondary eclipses. Overall, adding EV amplitude to the general (BLS) pipeline is a way to discover more EB systems and grow catalogs like VSX. Further research on these systems could include studies on aspects like stellar evolution, the common-envelope phase, and even the later stages of close binary mergers.

Awards Won:
Fourth Award of $600