Machine learning driven adaptive optics photometry and astrometry

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Abstract

Context: Photometry and astrometry of stellar clusters is a key methodology in contemporary astronomy. Adaptive optics images exhibit a significant degree of spatial and temporal variability in the point spread function, which is challenging for classical approaches. These rely on point spread function fitting to detect and compute photometric and astrometric quantities. Machine learning techniques are extremely popular due to their precision, reliability, and computational cost, and outperform their counterparts, especially on datasets with significant noise and variance. This is the particular context of adaptive optics.
Aims: Our goal is to develop an automatic point source detector that provides reliable and complete photometry and astrometry of stellar cluster fields.

Methods: We will use simulated adaptive optics images of clusters with the ground truth to train the network and to quantify: a) the source detection efficiency; b) the accuracy of the photometry and astrometry of machine learning driven algorithms compared to classical DAOPHOT-like approaches. We will then apply the algorithm to real data.
Results: We show that the algorithm has a significantly higher source detection efficiency than classical approaches. It also shows better performance in photometry. We discuss the details required for accurate astrometry."

Keywords: Point source detection, Adaptive Optics, Machine learning, Object detection, Deep learning, Simulated Images, Photometry

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