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DECONSTRUCTING A GALAXY: COLOUR DISTRIBUTIONS OF POINT SOURCES IN MESSIER 83

Abstract

What do we see when we look at a nearby, well-resolved galaxy? Thousands of individual sources are detected in multi-band imaging observations of even a fraction of a nearby galaxy, and characterizing those sources is a complex process. As observational technology advances, the size of astronomical surveys will continue to grow, and efficient means of analyzing the data they produce are necessary. Machine learning methods present an effective way to handle large datasets and are becoming a popular way to analyze large surveys in astronomy. This work analyzes a ten-band photometric catalog of nearly 70000 point sources in a 7.3 square arcminute region of the nearby spiral Messier 83, made as part of the Early Release Science program with the Hubble Space Telescope's Wide Field Camera 3. Measurements in different spectral bands were used to generate object colours. Colour distributions were measured for both broad-band and broad-and-narrow-band colours; colours made from broad bands with large wavelength differences generally had broader distributions, although B-V was an exception. Two and three dimensional colour spaces were generated using various combinations of four bands and were clustered with the K-Means and Mean-Shift algorithms. For the colour distribution present in the M83 point sources, clustering with K-means in three dimensions was found to be the most effective. K-Means clustering of the UBVI colour space could identify a group of objects consistent with star clusters. Mean-Shift was successful in identifying outlying groups at the edges of colour distributions. For identifying objects whose emission is dominated by spectral lines, there was no clear benefit from combining narrow-band photometry in multiple bands compared to a simple continuum subtraction. The clustering analysis results are used to inform recommendations for future surveys of nearby galaxies, leading to more effective surveying.