
Pix2Prof: fast extraction of sequential information from galaxy imagery via a deep natural language 'captioning' model

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Abstract

We present 'Pix2Prof', a deep learning model that can eliminate any manual steps taken when measuring galaxy profiles. We argue that a galaxy profile of any sort is conceptually similar to a natural language image caption. This idea allows us to leverage image captioning methods from the field of natural language processing, and so we design Pix2Prof as a float sequence 'captioning' model suitable for galaxy profile inference. We demonstrate the technique by approximating a galaxy surface brightness (SB) profile fitting method that contains several manual steps. Pix2Prof processes ~ 1 image per second on an Intel Xeon E5-2650 v3 CPU, improving on the speed of the manual interactive method by more than two orders of magnitude. Crucially, Pix2Prof requires no manual interaction, and since galaxy profile estimation is an embarrassingly parallel problem, we can further increase the throughput by running many Pix2Prof instances simultaneously. In perspective, Pix2Prof would take under an hour to infer profiles for 100,000 galaxies on a single NVIDIA DGX-2 system. A single human expert would take approximately 2 years to complete the same task. Automated methodology such as this will accelerate the analysis of the next generation of large area sky surveys expected to yield hundreds of millions of targets. In such instances, all manual approaches – even those involving a large number of experts – will be impractical.

Keywords: galaxy photometry, image captioning, recurrent neural networks, deep learning

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