Simulation and Segmentation with Deep Learning for Euclid

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Abstract

The incoming new generation of astrophysical surveys, with unprecedented depth and sky coverage, represent a challenge from the image analysis point of view.
Fast and accurate simulations are needed to calibrate the algorithms and understand the systematics. We propose the use of deep generative models, based on the work by Lanusse et al. (2020), to accurately and efficiently simulate realistic galaxies for the Euclid survey. Trained on observations from the Hubble Space Telescope, we show that the NNs generate galaxies which go beyond symmetric Sersic profiles, while keeping a control on the global galaxy shapes. Among others, these simulations are useful to understand the systematics of shear measurements on realistic galaxy shapes.

Deeper surveys imply a larger fraction of overlapping (blending) galaxies, which can also affect the accuracy of the cosmological measurements. We propose a Probabilistic Machine Learning approach (Proba U-net) for galaxy deblending in Euclid. The Proba U-net produces probabilistic segmentation maps of galaxy fields. Our preliminary results are very promising, in the sense that they present a meaningful pixel wise uncertainty, and a competitive completeness and purity.

We think that our work, showing the application of novel ML techniques to simulate and analyse Euclid imaging data, can potentially raise interesting discussions on the potential of machine learning applied to the new generation of astronomical surveys.

Slides: in PDF, and Keynote
Video: https://youtu.be/MY0_IQu4vd8

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