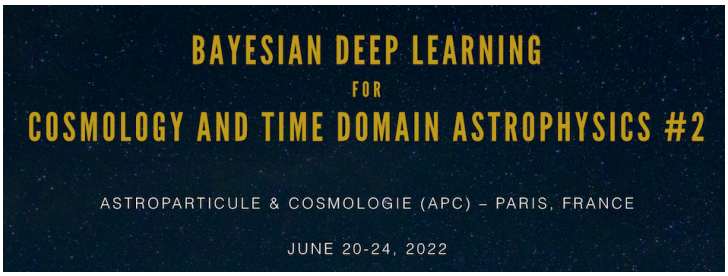

ID de Contribution: **54** Code de contribution: **cosmo_remote1** Type: **Talk**

Deblending Galaxies with Generative Adversarial Networks

Deep generative models including generative adversarial networks (GANs) are powerful unsupervised tools in learning the distributions of data sets. Various applications of GANs such as image generation, data/image to image translation, feature transfer, or super resolution could notably enhance astronomical data sets. Building a simple GAN architecture in PyTorch and training on the CANDELS data set, we generate galaxy images with the Hubble Space Telescope resolution starting from a noise vector. We proceed by modifying the GAN architecture to improve the Subaru Hyper Suprime-Cam ground-based images by increasing their resolution to the HST resolution. We use the super resolution GAN on a large sample of blended galaxies which we create using CANDELS cutouts. In our simulated blend sample, $\sim 20\%$ would unrecognizably be blended even in the HST resolution cutouts. In the HSC-like cutouts this fraction rises to $\sim 90\%$. With our modified GAN we can lower this value to $\sim 50\%$. We quantify the blending fraction in the high, low and GAN resolutions over the whole manifold of angular separation, flux ratios, sizes and redshift difference between the two blended objects. The two peaks found by the GAN deblender result in ten times improvement in the photometry measurement of the blended objects. Modifying the architecture of the GAN, we also train a Multi-wavelength GAN with seven band optical+NIR HST cutouts. This multi-wavelength GAN improves the fraction of detected blends by another $\sim 10\%$ compared to the single-band GAN. This is most beneficial to the current and future precision cosmology experiments (e.g., LSST, SPHEREx, Euclid, Roman), specifically those relying on weak gravitational lensing, where blending is a major source of systematic error.

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Classification de Session: Cosmology

Classification de thématique: Cosmology