Contribution ID: **49**   Type: **Poster Presentation**

Mimicking the halo-galaxy connection using machine learning

Wednesday, 1 June 2022 12:50 (3 minutes)

As far as we know, galaxies form inside dark matter halos and elucidating this connection is a key element in theories of galaxy formation and evolution. In this work, we propose a suite of machine learning (ML) tools to analyze these intricate relations in the IllustrisTNG300 magnetohydrodynamical simulation. We apply four individual algorithms: extremely randomized trees (ERT), K-nearest neighbors (kNN), light gradient boosting machine (LGBM), and neural networks (NN). Moreover, we combine the results of the different methods in a stacked model. In addition, we apply all these methods in an augumented dataset using the synthetic minority over-sampling technique for regression with Gaussian noise (SMOGN), in order to alleviate the problem of unbalanced datasets, and show that it improves the shape of the predicted distributions. Overall, the all the ML algorithms produce consistent results in terms of predicting central galaxy properties from a set of input halo properties that include halo mass, concentration, spin, and halo overdensity. For stellar mass, the (predicted vs. real) Pearson correlation coefficient is 0.98, dropping down to 0.7-0.8 for specific star formation rate, colour, and size. We also demonstrate that our predictions are good enough to reproduce the power spectra of multiple galaxy populations, defined in terms of stellar mass, sSFR, colour, and size with high accuracy. Our analysis adds evidence to previous works indicating that certain galaxy properties cannot be reproduced using halo features alone.

Main Topic

Supervised/Unsupervised/Semi-supervised Learning

Secondary Topic

Data preparation, generation and augmentation

Participation mode

Remote

Primary authors: SOLER MATUBARO DE SANTI, Natalí (University of São Paulo);   Ms VILLA NOVA RO-DRIGUES, Natalia (University of São Paulo);   Mr MONTERO-DORTA, Antonio D. (Universidad Técnica Federico Santa María);   Mr ABRAMO, Luis Raul (University of São Paulo);   Ms TUCCI, Beatriz (Max-Planck-Institut für Astrophysik);   Ms ARTALE, Maria Celeste (Universität Innsbruck)

Presenter: SOLER MATUBARO DE SANTI, Natalí (University of São Paulo)

Session Classification: Poster Session Day 3.1