
The Dark Quest project for cosmological emulation

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Abstract

Emulation is a useful technique that replaces costly numerical simulations with a cheaper statistical model, opening the potential of simulation-based inference. In large-scale structure cosmology, the challenge is in making accurate predictions of various observational probes, and N-body simulations enable us to do this task down to small scales where nonlinearity is significant. We launched a simulation campaign dubbed as "Dark Quest", primarily for the ongoing Subaru HSC survey. It aims at serving as a theoretical model for joint analyses of clustering and lensing observables. To account for the unknown galaxy-bias uncertainties, our DarkEmulator bases fully on the halo-model picture, and our Gaussian Process based emulator (and feed-forward neural network based variants) is connected with analytical halo-galaxy connection models, which can be designed by the user depending on the knowledge and the complexity of the galaxy sample in mind, without any need of additional training of the model. We discuss the details of the implementation as well as the performance of our early products recently made public (Dark Quest. I.), with some latest updates of the project.

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