

Title: DLA-VPS: Deep Learning Assisted Visual Parameter Space Analysis of Cosmological Simulations

Abstract: Cosmologists often build a mathematics simulation model to study the observed universe. However, running a high-fidelity simulation is time-consuming and thus can inconvenience the analysis. This is especially so when the analysis involves trying out a large number of simulation input parameter configurations. Therefore, selecting an input parameter configuration that can meet the needs of an analysis task has become an important part of the analysis process. In this work, we propose an interactive visual system, which efficiently helps users understand the parameter space related to their cosmological data. Our system utilizes a GAN-based surrogate model to reconstruct the simulation outputs without running the expensive simulation. We also extract information learned by the deep neural network-based surrogate models to facilitate the parameter space exploration. We demonstrate the effectiveness of our system via multiple case studies. These case study results demonstrate valuable simulation input parameter configuration and subregion analyses.