

COMoving Computer Acceleration (COCA): N-body simulations in an emulated frame of reference

lundi 28 octobre 2024 14:50 (20 minutes)

Interpretability and accuracy are pivotal challenges in the application of machine learning to cosmology. If machines find something humans don't understand, how can we check (and trust) the results? In this presentation, I contend that addressing this concern is not always obligatory, when machine learning is used to build an emulator of an expensive model. I will elucidate this argument through a case study where the use of neural networks is safe *by construction*. COMoving Computer Acceleration (COCA) is a hybrid framework interfacing ML with an N-body simulator. The correct physical equations of motion are solved in an emulated frame of reference, so that any emulation error is corrected by design. This approach corresponds to solving for the perturbation of particle trajectories around the machine-learned solution, which is computationally cheaper than obtaining the full solution, yet is guaranteed to converge to the truth as one increases the number of force evaluations.

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Classification de Session: Présentations