ID de Contribution: **28** Code de contribution: **Confirmed** Type: **Talk (submitted)**

Sampling high-dimensional posterior with a simulation based prior

jeudi 21 avril 2022 15:40 (15 minutes)

We present a novel methodology to address high-dimensional posterior inference in a situation where the likelihood is analytically known, but the prior is intractable and only accessible through simulations. Our approach combines Neural Score Matching for learning the prior distribution from physical simulations, and a novel posterior sampling method based on Hamiltonian Monte Carlo and an annealing strategy to sample the high-dimensional posterior.

In the astrophysical problem we address, by measuring the lensing effect on a large number of galaxies, it is possible to reconstruct maps of the matter distribution on the sky, also known as mass maps. But because of missing data and noise dominated measurement, the recovery of mass maps constitutes a challenging ill-posed inverse problem.

Reformulating the problem in a Bayesian framework, we target the posterior distribution of the mass maps conditioned on the galaxy shapes observations. The likelihood, encoding the forward process from the mass map to the shear map is analytically known, but there is no closed form expression for the full non-Gaussian prior over the mass maps. Nonetheless, we can sample mass maps from an implicit full-prior through cosmological simulations, taking into account non-linear gravitational collapse and baryonic effects. We use a recent class of Deep Generative Models based on Neural Score Matching to learn the full prior of the mass maps. Then, we can sample from the posterior distribution with MCMC algorithms, using an annealing strategy for efficient sampling in a high-dimensional space.

We are thus able to obtain samples from the full Bayesian posterior of the problem and can provide mass maps reconstruction alongside uncertainty quantifications.

Auteur principal: REMY, Benjamin (CEA Paris-Saclay)

Co-auteurs: LANUSSE, Francois ({CNRS}UMR7158); JEFFREY, Niall (École normale supérieure); Dr LIU, Jia (Kavli IPMU, University of Tokyo); STARCK, Jean-Luc (CosmoStat, CEA Paris-Saclay); OSATO, Ken (Institut d'Astrophysique de Paris); Dr SCHRABBACK, Tim (Argelander-Institut für Astronomie)

Orateur: REMY, Benjamin (CEA Paris-Saclay)

Classification de Session: Talks