BAYESIAN COMPUTATION WITH PLUG AND PLAY PRIORS FOR POISSON INVERSE PROBLEMS

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In this work, we investigate Poisson image restoration problems using Bayesian computation, enabling uncertainty quantification (UQ) on the obtained results. The proposed strategies are based on discretisations of the Langevin stochastic differential equation modified to deal with poor regularity properties of the log-posterior target distributions. We investigate two different approaches: One option is to use modifications of the Euclidean unadjusted Langevin algorithm (ULA) using non-negativity constraints and a Lipschitz approximation of the likelihood. An alternative approach is to use sampling schemes derived from Riemannian Langevin diffusion algorithms, using a metric capturing the local geometry of the log-posterior. The resulting mirror-descent like sampling algorithms use Bregman divergences to alter the geometry of the potential through a mirror map and impose a smooth approximation of the potential. We explore how data-driven Plug and Play (PnP) priors can be incorporated within Euclidean and mirror Langevin algorithms building on prior work about PnP-ULA and Mirror Monte Carlo methods. We explore several state-of-the-art denoising network priors and show that the choice of network prior is crucial. We highlight how we can obtain state-of-the-art reconstruction results with UQ, present examples of advanced Bayesian inferences and give a perspective on future work.