Fully Stochastic Reconstruction for Inverse Radiative Transport

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Abstract

The Radiative Transport Equation (RTE) arises in applications in tomography based on photon propagation. Whereas it has a direct solution for non-scattering media it is complicated to solve for cases involving significant scattering. In these cases, Monte Carlo (MC) methods are a widely applicable and accurate class of modelling techniques that converge to the deterministic solution in the limit of an infinite number simulated photons.
Classical methods for solving the inverse problem that involve a non-linear optimisation approach can be combined with advances in stochastic subsamplings strategies that are in part inspired by machine learning applications. In such approaches the forward problem is considered deterministic and the stochasticity involves splitting of an objective function into sub functions that approach the fully sampled problem in an expectation sense.
In this work we consider where the forward problem is also solved stochastically, by a Monte Carlo simulation of photon propagation. By adjusting the batch size in the forward and inverse problems together, we can achieve better performance than if subsampling is performed separately.

Joint work with : Z Kereta, J Kangasniemi, N Hänninen, A Pulkkinen, T Tarvainen

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