Conservative SPDEs as fluctuating mean field limits of stochastic gradient descent

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In my talk, the convergence of stochastic interacting particle systems in the mean-field limit to solutions to conservative stochastic partial differential equations will be shown. We will discuss the optimal rate of convergence and derive a quantitative central limit theorem for such SPDEs. The results are applied in particular to the convergence in the mean-field scaling of stochastic gradient descent dynamics in overparametrized, shallow neural networks to solutions of SPDEs. Moreover, we will see that the inclusion of fluctuations in the limiting SPDE improves the rate of convergence, and retains information about the fluctuations of stochastic gradient descent in the continuum limit.

The talk is based on joint work with Benjamin Gess and Rishabh S. Gvalani [1], [2].

1. Benjamin Gess, Rishabh S. Gvalani, and Vitalii Konarovskyi, Conservative SPDEs as fluctuating mean field limits of stochastic gradient descent, 2022, 63p, arXiv:2207.05705
2. Benjamin Gess, Rishabh S. Gvalani, and Vitalii Konarovskyi, Stochastic Modified Flows, Mean-Field Limits and Dynamics of Stochastic Gradient Descent, 2023, 24p, arXiv:2302.07125