Contribution ID: **22** Type: **not specified**

On convergences of the square root approximation scheme to the Fokker- Planck operator

Thursday, August 30, 2018 4:55 PM (35 minutes)

We study the qualitative convergence behavior of a novel FV-discretization scheme of the Fokker-Planck equation, the squareroot approximation scheme (SQRA), that recently was proposed by [Lie, Fackeldey and Weber 2013] in the context of conformation dynamics. We show that SQRA has a natural gradient structure related to the Wasserstein gradient flow structure of the Fokker-Planck equation and that solutions to the SQRA converge to solutions of the Fokker-Planck equation. This is done using a discrete notion of G-convergence for the underlying discrete elliptic operator. The gradient structure of the FV-scheme guaranties positivity of solutions and preserves asymptotic behavior of the Fokker-Planck equation for large times. Furthermore, the SQRA does not need to account for the volumes of cells and interfaces and is taylored for high dimensional spaces. However, based on FV-discretizations of the Laplacian it can also be used in lower dimensions taking into account the volumes of the cells. As an example, in the special case of stationary Voronoi tessellations we use stochastic two-scale convergence to prove that this setting satisfies the G-convergence property.

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