Inverting Markovian Projections: Weak Error Rates for Local Stochastic Volatility Models

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Local stochastic volatility refers to a popular model class in applied mathematical finance that allows for "calibration-on-the-fly". These models aim to replicate the one-dimensional marginal distributions of local volatility models (which are Markovian SDEs), while still allowing for a stochastic volatility component, which is typically non-Markovian.

The governing SDEs from these models arise from inverting the Markovian projection, originally established by Győngyi, resulting in coefficients that depend on conditional expectations of the solution itself. While well-posedness of the equation remains a largely open problem, our take is to start with a well-defined Euler approximation.

We then establish a novel half-step-scheme that allows for good approximations of conditional expectations. After introducing a regularisation parameter, we formulate an interacting particle system, transforming it to a well-posed McKean-Vlasov Half-Step Euler scheme. Assuming a solution to the original problem exists, by a mimicking argument we then quantify the weak error rate of the particle system with respect to all parameters involved.