Calibration of models governed by stochastic differential equations using time-dependent data

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To study the nonlinear properties of complex fluids, the movement of particles within them is usually represented by systems of coupled nonlinear stochastic differential equations [1, 2]. These equations typically contain several parameters chosen carefully to match the experimental data and to validate the effectiveness of the model. However, few methods exist for calibrating this choice of parameters. We present a discretize-before-optimize approach that uses time-dependent data to solve the calibration problem for models with two or more particles. We derive an optimality system characterizing the solution to the calibration problem within the Lagrange framework and use it to formulate a stochastic gradient method. We apply Monte Carlo methods to solve the arising equations, using parallelization strategies to compensate for the high equilibration time. We test and validate the model and the optimization strategy using data generated in physical experiments for the stochastic Prantl-Tomlinson model. Our approach is very general and can be applied to a variety of physical models.

References:

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