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Pathwise analysis of random systems

Stochastic (partial) differential equations play a fundamental role in our study of the physical world, from homogenisation of dynamical systems to the construction of quantum fields. In classical stochastic analysis (Itô calculus), solutions to SDEs are completely probabilistic objects, typically constructed using martingale methods. The past two decades has seen the development of several pathwise methods to solve S(P)DEs, including the theories of rough paths, regularity structures, and paracontrolled distributions. In this talk, I will explain how one can treat SPDEs in a pathwise manner and the advantages that this approach has for certain problems. I will in particular describe how pathwise analysis can be used to construct and analyse classical quantum fields, and the implications this has on future developments of singular SPDEs and constructive quantum field theory.