Stochastic backward error analysis: application to Hamiltonian systems

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In this talk, we address our attention on the geometric numerical integration of stochastic Hamiltonian systems, under the backward error analysis perspective. Firstly, we consider symplectic numerical integrators for canonical stochastic Hamiltonian systems. In order to gain insights on the behaviour of the long-term Hamiltonian error that arises along the aforementioned numerical dynamics, we construct stochastic modified equations, whose exact solutions coincide with such numerical ones. Then, a rigorous study of such exact solutions will follow to capture the eventual conservative properties of the associated numerical methods. This methodology will allows us to get an extension of the well-known *Benettin-Giorgilli Theorem* to the stochastic scenario, explaining the long-term trend of Hamiltonian errors along symplectic numerical integrators. Then, the extension to the case of stochastic Poisson systems will be also studied. In this scenario, the aim is to detect the behaviour of stochastic Poisson integrators, in terms of preserving the Hamiltonian function associated to the so-called *Wong-Zakay approximating system*, i.e., a stochastic system obtained upon approximating the Wiener process with a linear (in time) combination of Wiener increments. Finally, a selection of numerical experiments will be displayed, confirming the effectiveness of the theoretical analysis. This is a joint project with Raffaele D'Ambrosio (University of L'Aquila).

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