3:55-4:30 Adrien Busnot Laurent (Inria Rennes, France)

Intrinsic integrators for the weak and ergodic approximation of stochastic dynamics on manifolds

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In stochastic optimization, molecular dynamics, quantum physics, or in the training of neural networks, one is interested in sampling from the law of stochastic processes. These dynamics are often subject to geometric constraints (fixed distance between particles, constraints on weights in PINNs,). In this context, it is crucial to develop numerical approaches that take into account both the geometric and random features of the dynamics. The literature relies mostly on penalty formulations or extrinsic numerical integrators. These solutions are costly, subject to significant time-step restrictions, and require formulation of the dynamics in much higher-dimensional spaces. In this talk, we present a general new class of methods that rely on intrinsic geometric operations, a new robust convergence analysis in the weak sense and for ergodic approximations, and an algebraic approach with Hopf algebras of planar exotic forests and Butcher series for the calculation of order conditions. A second order integrator that generalises the celebrated Leimkuhler-Matthews method is presented.