Geometric nonholonomic integrators

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R 1.23 Tue Z3 11:00-11:10

In this talk we will explore some new results in the construction of geometric integrators for a particuar type of constrained systems: nonholonomic mechanics where the dynamics is restricted by nonintegrable constraints on velocities. One of its most remarkable properties is that the derivation of the nonholonomic equations is not variational. However, we have recently discovered that mechanical nonholonomic systems may be seen as variational if we choose an appropriate Riemannian structure. In fact, we may show slightly more: its trajectories are geodesics relative to this structure so that, in particular, they are length minimizing! See Anahory Simoes, A., Marrero, J. C., Martín de Diego, D.: Radial kinetic nonholonomic trajectories are Riemannian geodesics!. arXiv:2010.12444, 2020.). We will define a Riemannian structure on this submanifold and show that nonholonomic trajectories starting at a fixed point q of the configuration space are geodesics relative to the new Riemannian manifold. The case of mechanical nonholonomic systems will not be addressed with detail because we also show that its trajectories are reparametrizations of that of kinetic nonholonomic system associated to the Jacobi metric.
Finally, we will discuss how this theoretical machinery may be used to construct geometric integrators for nonholonomic mechanics.