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Geometric structure of certain nonholonomic systems with symmetry: integrability and Hamiltonisation

In Hamiltonian mechanics the conservation of the momentum map establishes a well understood relation between the presence of symmetries and the existence of conserved quantities. If constraints in the velocities are taken into account, the situation changes drastically: the variational and hence the Hamiltonian features typical of conservative holonomic mechanics are broken and in particular Noether's Theorem does not hold anymore. Besides that, in the last forty years there has been various approaches to extend Noether Theorem to the nonholonomic framework, and many interesting structures and results, as nonholonomic momentum map, nonholonomic reduction, Hamiltonisation and gauge momenta have been introduced and obtained. In this talk I will firstly recall the basic concepts of nonholonomic systems, symmetries, nonholonomic momentum maps, horizontal gauge momenta, and Hamiltonisation. Then I will give a result that allows to determine the number of horizontal gauge momenta that certain nonholonomic systems with symmetry may admit and also a method to compute them. I will then relate the existence of horizontal gauge momenta to the problem of Hamiltonisation and integrability of certain type systems.

This talk is based on an ongoing collaboration with Paula Balseiro from Fluminense Federal University - Brazil.