Variational metric structures

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Abstract:

We shall be interested in relations between Lagrangian structures, metric structures, and semispray (Ehresmann) connections on smooth manifolds. Generalized Finsler structures will be introduced, coming from integrable time, position and velocity dependent metrics. For every such a generalized metric one has a naturally associated semispray connection, so-called canonical connection, and a global Lagrangian, a generalized kinetic energy. These nonlinear connections represent the most general form of metrizable connections whose related equations for geodesics are variational. As expected, the canonical connection generalizes the Levi-Civita connection and the corresponding connection appearing in Finsler geometry. We shall also discuss relations between metrizability of semispray connections and the existence of variational integrators for second-order ordinary differential equations (so-called Inverse Problem of the Calculus of Variations).