Dirac Algebroids
in Lagrangian and Hamiltonian Mechanics

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A unified approach to constrained implicit Lagrangian and Hamiltonian systems based on
the introduced concept of Dirac algebroid is proposed. The latter is a certain almost Dirac
structure associated with the Courant algebroid $TE^* \oplus_M T^*E^*$ on the dual $E^*$ to a vector
bundle $\tau : E \to M$. If this almost Dirac structure is integrable (Dirac), we speak about
a Dirac-Lie algebroid. The bundle $E$ plays the role of the bundle of kinematic configura-
tions (quasi-velocities), while the bundle $E^*$ – the role of the phase space. This setting is
totally intrinsic and does not distinguish between regular and singular Lagrangians. The
constraints are part of the framework, so the general approach does not change when non-
holonomic constraints are imposed and produces the (implicit) Euler-Lagrange and Hamilton
equations in an elegant geometric way. The scheme includes all important cases of Lagrangian
and Hamiltonian systems, no matter if they are with or without constraints, autonomous or
non-autonomous etc., as well as their reductions; in particular, constrained systems on Lie
algebroids.

References


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