Desingularization of Implicit Analytic Differential Equations

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Abstract

Implicit differential equations appear naturally in physics and engineering problems. Diract theory of constraints, nonholonomic systems, control systems, are some of the examples. Basic questions like existence, uniquenes, extendability of solutions, are not completely studied in the existing literature, to the best of my knowledge. I will show how to reduce a given implicit differential equation, at least in the anlytic case, to an implicit analytic equation of locally constant rank, for which those basic questions have an easy answer. This can be done by using desingularization techniques. An important point here is to prove the equivalence between the given system and the reduced systems. The reduction algorithm involves ideas related to the Gotay-Nester approach to Dirac theory of constraints, and also to the usual way of dealing with differential-algebraic systems.