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Algebraic Constraints on Initial Values of Differential Equations

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Abstract: Initial value problems of differential algebraic equations are of practical importance in many applications. Three related problems have been investigated: singularities, numerical solutions, and existence and uniqueness of solutions. We will briefly discuss the difficulties posed by each. In this talk, we describe a computational approach to obtain algebraic constraints on initial values that would guarantee existence and uniqueness of solutions. These constraints may be implicitly implied by the differential equations themselves. We apply this approach to a class of non-linear systems of first order ordinary differential equations and in addition to obtaining the constraints, the algorithms will also provide equivalent systems where the first derivatives of the dependent variables (unknowns) are explicitly given in terms of the unknowns. This vector field can be integrated in a numerically stable way. Examples where singularities are exposed by the algorithm will be given.

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