A Matlab Tool for Structural Analysis of DAEs

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Ned Nedialkov and John Pryce are the authors of DAETS, a C++ code for solving high-index, any order differential-algebraic equations (DAEs). It is based on Pryce's structural analysis (SA) theory and a Taylor series expansion of the solution. Although DAETS can be used for SA, to facilitate our research, we needed a much "lighter", stand-alone tool for SA of DAEs.

Over the years, we have been using Matlab to investigate the structure of numerous DAE problems, which resulted in the Matlab DAESA tool (also based on Pryce's SA). The user can specify a DAE in a general form: it can be of high-index, fully implicit, and contain derivatives of order higher than one. DAESA reports the structural index of a DAE, its degrees of freedom, what variables and derivatives need to be initialized (when specifying initial conditions) and what equations and how many times to be differentiated to reduce to an ODE.

We outline the theory of Pryce's SA, the implementation of DAESA, and illustrate its capabilities on several examples.