DAETS: a Differential-Algebraic Equation code in C++ for high index and high accuracy

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Abstract

Ned Nedialkov (McMaster University, Canada) and John Pryce (Cranfield University, UK) are the authors of DAETS, a C++ code for solving differential-algebraic equations (DAEs), version 1.0 of which has just been released. It uses Pryce's structural analysis theory, and expands the solution in Taylor series using automatic differentiation. DAETS is very effective when high accuracy is required, and at solving problems of high index---we have solved artificial DAEs of index up to 47. It is versatile: higher-order systems do not have to be cast in first-order form; it can solve explicit and implicit ODEs; it can solve purely algebraic problems, by simple or by arc-length continuation.

This talk will outline the theory and algorithms behind DAETs and the code structure of DAETS. We give examples of code's performance on standard test problems, as well as on an index-15 DAE, and a pure algebraic system solved as an implicit index-1 DAE using continuation.