A least-squares collocation method for non-linear higher index differential-algebraic equations

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Differential-algebraic equations (DAEs) with higher index give rise to essentially ill-posed problems. We regularize the DAEs by a least-squares collocation method. Its realization is not much more computationally expensive than standard collocation methods used in the numerical solution of ordinary differential equations and index-1 DAEs. Thus, it is much cheaper than methods based on index reductions. In numerical experiments, this approach has displayed excellent convergence properties both for linear and non-linear DAEs. A strict convergence proof has been given earlier for the general class of linear index-μ tractable DAEs.
The present paper is devoted to present new results about the convergence of this least-squares collocation method and a Gauss-Newton scheme for non-linear DAEs under rather general conditions