

Structural Analysis and Dummy Derivatives

R. McKenzie¹, J. Pryce², G. Tan³ and N. Nedialkov⁴

¹Cardiff University, mckenzier1@cardiff.ac.uk

²Cardiff University, j.d.pryce@cantab.net

³McMaster University, tgn3000@msn.com

⁴McMaster University, nedialk@mcmaster.ca

Differential-algebraic equations (DAEs) appear frequently in applications involving equation-based modelling. A common way of making a high-index DAE amenable to numerical solution is by reducing it to a corresponding index 1 (or index 0) system, as is done in the Dummy Derivative method [1]. The structural analysis method in [2] suggests a solution scheme based on Taylor series, where computing the series proceeds in stages. We draw comparisons between these stages and those of dummy derivatives, showing the structural analysis method is in some sense equivalent to the dummy derivative index method. We conclude by showing the choice of dummy derivatives can be informed by the structural analysis.

References

- [1] S. Mattsson and G. Söderlind, Index Reduction in Differential-Algebraic Equations Using Dummy Derivatives, *SIAM J. Sci. Comput.* 14, 4, pp.677692 (1993).
- [2] J. Pryce, A Simple Structural Analysis Method for DAEs, *BIT.* 41, 2, pp. 364394 (2001).