Progress on the DAESA tool for structural analysis of DAEs

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Large DAE systems are produced by equation-based modeling methods in many engineering and scientific disciplines. It is now routine that they are generated by software using interactive systems such as gPROMS or DYMOLA. Mostly these have some kind of structural analysis (SA) of the DAE built in.

For some years the authors have been developing a numerical code DAETS for solving DAEs. It is based on a SA of the sparsity of the DAE that we call the signature matrix method. In many ways it is equivalent to the well-known method of Pantelides, and computes the same structural index, but is easier to use.

Originally, our SA was merely a preprocessing stage to set up the numerical solution method for DAETS. However, as we have encountered users with increasingly large problems, it has become clear that they value its diagnostic abilities, not all of which are present in other systems, although there is a large overlap. In particular, our SA is able to identify subsystems of a DAE to a finer resolution than many other methods. Thereby, it can often reduce the number of initial values required for numerical solution, beyond what those other methods achieve—a useful feature in view of the notable difficulty of estimating consistent initial values for a DAE.

Thus it seemed useful to present it as a free-standing tool, with enhanced reporting and diagnostic capabilities. The result is the program DAESA. Written in MATLAB, it accepts a MATLAB description of a DAE similar to the C++ description accepted by DAETS.

DAESA is under active development. The talk will show examples of its use on small and on larger problems. In view of the workshop theme we would welcome discussion of how its SA compares with that of other systems and how to improve it further.

References

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