Input Compression for the Dynamic Sigma Method

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Structural Analysis of Differential Algebraic Equations is a computationally expensive task, because it relies on the solution of a highest value assignment in the bipartite structure graph of the model. Therefore the size of models that can be simulated is limited in practice by the runtime of the index reduction method. It is possible to optimize the analysis by leveraging structural properties of hierarchical models: If a sub-component contains one more equation than protected variables, its protected variables may be removed from the structure graph by a compression transformation, thus reducing its size. A corresponding decompression operation allows to compute a highest-value assignment for the original graph from the compressed one. This can lead to drastically reduced runtime for the structural analysis of large models.
While this method works well in static systems, it is an open question, if it could also be useful in the case of structural variable models. While the Dynamic Σ-Method [1] offers fast structural analysis for these systems, it depends on a change description broken down to rows and columns of the Σ-matrix. Hence it is either necessary to over-approximate the actual change description (and thus probably increase the runtime of the analysis) or to uncompress all affected components first. This talk will discuss both strategies and the requirements for their efficient implementation.

References

[1] C.Höger,, *Dynamic Structural Analysis for DAEs*. Proceedings of the 2014 Summer Simulation Multi-Conference, July 6-10, 2014, Monterey, California,