Efficient Compilation of Large Scale Dynamical Systems

Federico Bergero[1,2] Mariano Botta[2] Esteban Campostrini[2] Federico Moya[2]
Ernesto Kofman[1,2]

[1]CIFASIS, CONICET, Argentina {bergero,kofman}@cifasis-conicet.gov.ar
[2]FCEIA, UNR, Argentina
{marianoabotta,lesteban22,federicoamoya}@gmail.com

In this work, we present a novel methodology to efficiently compile large scale dynamical systems described as Modelica models, and its implementation in a prototype Modelica Compiler called ModelicaCC. The methodology allows to perform the different stages of the compilation process without expanding the content of repetitive structures so the resources (CPU time and memory) used by the compiler result independent on the model size. Besides introducing the methodology with their algorithms and the implementation in the ModelicaCC compiler, we analyze their efficiency comparing its performance with that of OpenModelica in different large scale models.

Flattening Phase We present an article to efficiently flatten large scale models without expanding equation and array variables. The first step is obtaining equivalent flat non-expanded models from each component. The second step is replacing the `connect` equations amongst these components for equality equations. This is achieved thorough an algorithm thats computes the connected components in a augmented graph.

Causalization Phase The DAE system resulting from then flattening stage must be then sorted into an ODE. This works presents also an extension on the Tarjan algorithm to deal with iterative equations and array variables without unrolling them. This is again achieved with the use of an augmented graph holding information about array indexes and `for` iterative variable.

Results The presented algorithms were implemented in a prototype Modelica C++ Compiler in order to study their behavior. The results show that over the two case studies presented this approach has a constant compilation time with respect to the model size.

Work is being done to include algebraic loops in the causalization phase. Index Reduction must also be included based on the work of [1].

References

[1] M. Arzt, V. Waurich, and J. Wensch. Towards Utilizing Repeating Structures for Constant Time Compilation of Large Modelica Models. In *Proceedings of the 6th International Workshop on Equation-Based Object-Oriented Modeling Languages and Tools*, EOOLT '14, pages 35–38, Berlin, Germany, 2014.