

DOML - a Compiler Environment for Dynamic Optimization Supporting Multiple Solvers

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The Modelica language may serve well as a base for defining optimal control problems, given a few relatively minor syntax extensions. One example proving that point is Optimica (initially proposed in [1]) and another one is DOML (Dynamic Optimization Modeling Language) – installed on IDOS (Interactive Dynamic Optimization Language, on-line at [4]) and described in the paper. The DOML implementation is, actually, heavily based on the (open source) compiler of Optimica (available at [3]) but it provides a number of important features absent in its precursor.

One main extension of the compiler lies in its built-in mechanism supporting the use of many different optimization solvers (selected on the fly, depending on the content of the problem definition) and to seamlessly add new, external, solvers. We find the need for implementing support for multiple solvers to be justified and intuitive. For once, dynamic optimization problems come in many different kinds (e.g. parametric, minimum time, DAE with higher index, etc) and so one solver would not be general enough to solve all of them efficiently and accurately; solvers dedicated to particular problem kinds simply do the job better. The second reason is to open the possibility for applying "solver chaining" i.e. a strategy of using two (or more) solvers consecutively on one problem. The first one yields a crude approximation while the next guarantees a more accurate solution but requires a reasonably good initial guess (and possibly other warm-starting information) – that may be taken from the first solver. For more details see e.g. [2].

In result, the range of problems that may be specified with DOML and solved in the IDOS environment is quite wide and keeps growing. The scope of problem ranges from some static optimization problems through regular ODE, parametric optimization, minimum time problems, up to DAE with higher index. DOML language extensions also provide preliminary support for multi-objective optimization and PDE problems.

References

- [1] Åkesson J. Tools and Languages for Optimization of Large-Scale Systems. Lund, Sweden: *PhD thesis*, Department of Automatic Control, Lund University, 2007.
- [2] Pytlak R, Błaszczak J, Krawczyk K, Tarnawski T. Solvers chaining in the IDOS server for dynamic optimization. In: Proceedings of 52nd Conference on Decision and Control, Florence, Italy, 10-13 December 2013.
- [3] Open Source Project: JModelica.org. <http://www.jmodelica.org/>. November 2013.
- [4] Interactive Dynamic Optimization Server. <http://idos.mchtr.pw.edu.pl/>. November 2013.