# Parallel Multiple-Shooting and Collocation Optimization with OpenModelica

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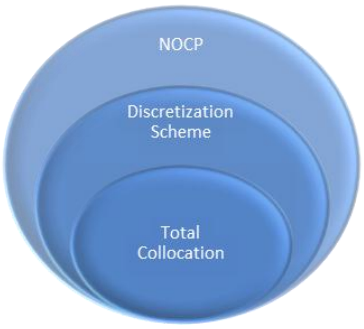
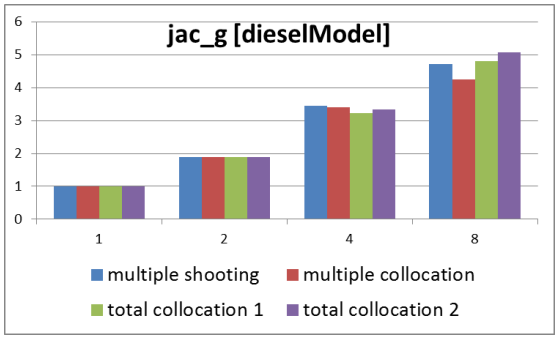



Nonlinear model predictive control (NMPC) has become increasingly important for today's control engineers during the last decade. In order to apply NMPC a nonlinear optimal control problem (NOCP) must be solved which in general needs high computational effort. State-of-the-art solution algorithms are based on multiple shooting or collocation algorithms, which are required to solve the underlying dynamic model formulation. This paper describes a general discretization scheme applied to the dynamic model description which can be further concretized to reproduce the well-known multiple shooting or collocation method (see also [1]). Furthermore, this approach can be refined to represent a total collocation algorithm [2] in order to solve the underlying NOCP much more efficiently. Further speedup of optimization has been achieved by parallelizing the calculation of model specific parts (e.g. constraints, Jacobians, etc.).

The corresponding discretized optimization problem has been solved by the interior optimizer Ipopt [3]. The proposed parallelized algorithms have been tested on different applications. As industrial relevant application an optimal control of a Diesel-Electric power train has been investigated. Speedup curves for parallel execution are presented.




## References

[1] Tamimi, Jasem. 2011. Development of Efficient Algorithms for Model Predictive Control of Fast Systems. Düsseldorf: VDI Verlag, 2011.

[2] Biegler, Lorenz T. 2010. Nonlinear Programming: Concepts, Algorithms, and Applications to Chemical Processes. s.l. : Society for Industrial Mathematics, 2010.

[3] Interior Point OPTimizer (Ipopt), https://projects.coin-or.org/Ipopt