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Master Thesis Proposal – ESE/MST/SSE/Math

Performance Study of Hessian Approximations for SQP solvers within acados

In real-time optimization, efficient and reliable optimization solvers are crucial for good practical performance. The high-performance framework acados implements a Sequential Quadratic Programming (SQP) method. Among other components, its performance is heavily influenced by a good Hessian approximation or regularization scheme. If the approximation is bad, the solver may suffer from bad convergence which limits the applicability of the solver. On the other hand if the approximation reflects the curvature information of the problem, the solver may converge very well.

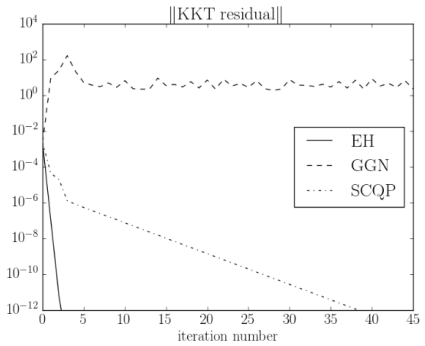

Figure 1: Convergence behavior of exact Hessian, General Gauss Newton and SCQP Hessian on a cart pendulum problem. of a Heat Storage System, from [1]

Master topic: The goal of the thesis is to explore the convergence behavior of different Hessian approximations and regularization schemes for SQP solvers within the acados solver framework. The master thesis consists of a theory part where regularization strategies are analyzed and compared. In a practical part the different regularization and approximation schemes are benchmarked against each other. The ultimate goal is to identify the best general purpose method.

Your skills: Prior knowledge in (numerical) optimization is advisable. The implementation will be in C and Python. Knowledge of the CasADi toolbox will be helpful.

Supervisors and contacts: Prof. Dr. Moritz Diehl, Jonathan Frey, David Kiessling

If you are interested, please contact Jonathan Frey or David Kiessling:

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[1] Verschueren R., Van Duijkeren N., Quirynen R., Diehl M. (2016). Exploiting Convexity in Direct Optimal Control: a Sequential Convex Quadratic Programming Method. In Proceedings of 2016 CDC.