

# Real-Time Model Predictive Control

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The purpose with this project is to investigate how Model Predictive Control performs when applied to fast processes under real-time demands. In particular, it is interesting to investigate the performance of methods that *guarantee* real-time performance. Traditionally, the real-time properties of MPC have relied on extensive testing, possibly together with some kind of “backup solution” if no solution is available at the next sampling instant. In recent research new methods have been proposed which deal with this problem in a more systematic way. The purpose with this work is to investigate and compare these new strategies and to compare with existing strategies which do not explicitly take real-time demands into account. The investigation starts with simulations, but the goal is to be able to perform tests on a challenging physical system as well. The main topics in the project are

- Review of previous work
  - Which approaches are able to give real-time guarantees in a strict sense.
  - What performance can be expected according to the literature for these approaches.
- Download code for, or possibly implement, some interesting strategies and compare in Matlab.
- Compare with existing state-of-the-art-methods already available in Matlab that are not able to guarantee real-time properties.
- Elaborate on the questions: Is there a “price” for a real-time guarantee? How much is that?
- Extra tasks (depending on time)
  - Try new ideas (research level with possible publication as outcome) on how to compute a worst-case limit on the number of iterations for classical methods of a certain type.
  - Apply to real-world process (more practical, could potentially involve some C-coding).

A typical background for this project is a Y or D student who has taken advanced control courses as Control theory and Optimal control. Interest in applied automatic control and optimization is of course also beneficial. If the iteration

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bound task is chosen, it is important with an interest in (or at least an interest to learn) optimization algorithms. If the practical implementation task is chosen, it is important with an interest for programming of embedded systems.

If there are some ideas of changes to the project, we are open for such discussions. Please send me an e-mail or pass by my office if you are interested, and we can discuss a tailored project for your interests and background!