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B A C H E L O R T H E S I S
 for
 N.N.
 Student ID XXXXXXXX, Degree XX-XX

Compute Torque Control with Gaussian Process Regression for Robotics

Problem description:

Computed-torque control requires a very precise dynamical model of the robot for compensating the manipulator dynamics. This allows reduction of the controller's feedback gains resulting in disturbance attenuation and other advantages. Finding precise models for manipulators is often difficult with parametric approaches, e.g. in the presence of complex friction or flexible links [3].

Therefore, various computed-torque control laws which rely on feed forward compensation with non-parametric models have been proposed [1]. More particular, for Gaussian Processes Regression it has been shown that the resulting tracking error is bounded [2]. However, the proposed method has only been tested on low dimensional systems and a verification on a full-scale robotic manipulator is still missing.

Therefore, this thesis aims to implement the existing method on a system with multiple degrees of freedom and perform all required adaptations. The goal is a evaluation and comparison with classical computed torque approaches.

Tasks:

- Literature research on computed torque control and Gaussian processes
- Implementation and adaptation of the existing approach to a manipulator with multiple degrees of freedom
- Evaluation, comparison and documentation of the results

Bibliography:

- [1] Nicolas Torres Alberto, Michael Mistry, and Freek Stulp. Computed torque control with variable gains through Gaussian process. In *International Conference on Humanoid Robots (Humanoids)*, pages 212–217. IEEE, 2014.
- [2] T. Beckers, J. Umlauf, and S. Hirche. Stable model-based control with gaussian process regression for robot manipulators. In *Proceedings of the 20th IFAC World Congress*, 2017.
- [3] Bruno Siciliano and Oussama Khatib. *Springer handbook of robotics*. Springer Science & Business Media, 2008.

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