Chair of Automatic Control

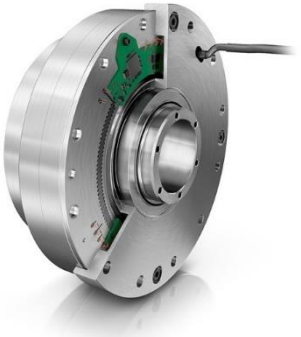
FAU

Master theses

Different topics regarding fault detection in strain wave gears

Motivation

Strain wave gears – also known as harmonic drive gears – are often incorporated into joints of robots due to their compact design and high gear ratio at the same time. In fully automated factories of the future, robots are in permanent operation, which implies a high demand on the life time of the robot and in particular the strain wave gears. Therefore, continuously monitoring their health state and the detection of anomalies is of high interest. To this end, the the current of the driving motor or the signal of its controller can be exploited for this task. Furthermore, physical parameters can be estimated and tracked to gain further insights.



Sensorized Strain wave gear.
Source: https://schaeffler.de.

Task description

In a thesis/research project, multiple areas of research are possible.
When considering the control input, a benchmark case with a standard PI controller has to be established. In a further step, the suitability of iterative learning and adaptive controllers can be studied and their potential to solve this task should be evaluated

The current of the driving motor is an easy accessible variable that directly correlates to the torque on the input side of the gear. The potential of this signal for fault detection purposes should be evaluated. Furthermore, the applicability for different motor types like IPMSM, DC, or axial flux motors is to be studied.

Finally, the tracking of physical parameters can provide comprehensible information about the condition of the gear. These parameters can be estimated by Kalman filter approaches or moving horizon estimation. Furthermore, optimization based approaches (maximum likelihood estimation or Bayes optimization) to obtain the parameters of a strain wave gear model can be of advantage. The potential of different approaches can be evaluated and compared.

Requirements

Basic knowledge of control theory and robotics, as well as programming experience in Matlab/Simulink and/or Python are required.

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