TECHNISCHE UNIVERSITÄT MÜNCHEN
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M A S T E R ' S T H E S I S
for
Student's name
Student ID 0815, Degree EI

Gaussian Process Latent Variable Dynamical Models for Motor Symptom Estimation in People with Parkinson's Disease

Problem description:

Parkinson's disease is a degenerative disorder of the central nervous system that affects the motor system. A patient's motor symptoms can be estimated from wrist-worn sensor data in real time allowing a personalized treatment of the disease. However, the relationship between motion data and severity of motor symptoms is highly complex in real world scenarios. An approach to solve this problem is the application of supervised machine learning to this problem, e.g. Gaussian process regression [1]. Considering the temporal correlation of symptom severity as a dynamical system has been found to be an efficient method to improve the regression performance in other problems such as human motion estimation [3]. Since it turns the inference with Gaussian processes analytically infeasible, variational methods are commonly employed in these problems [2].
The aim of this work is the development of a Gaussian process latent variable dynamical model that can be used to estimate the motor symptoms in people with Parkinson's disease. Finally, the model is trained and evaluated on a real-world data set.

Tasks:

- Literature research on Gaussian process latent variable methods
- Development of an Gaussian process latent variable dynamical model for Parkinson's disease
- Performance comparison to existing approaches

Bibliography:

[1] Muriel Lang, Urban Fietzek, Jakob Fröhner, Franz M. J. Pfister, Daniel Pichler, Kian Abedinpour, Terry T. Um, Dana Kulić, Satoshi Endo, and Sandra Hirche. A Multi-layer Gaussian Process for Motor Symptom Estimation in People with Parkinson's Disease. *IEEE Transactions on Biomedical Engineering*, pages 1–11, 2019.

[2] Michalis K. Titsias and Neil D. Lawrence. Bayesian Gaussian Process Latent Variable Model. In *Proceedings of the 13th International Conference on Artificial Intelligence and Statistics*, pages 844–851, 2010.

[3] Jack M. Wang, David J. Fleet, and Aaron Hertzmann. Gaussian Process Dynamical Models for Human Motion. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 30(2):283–298, 2008.

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