CPP 111: Data analytics for dynamical systems II (joint session SOE/CPP/DY)

Time: Friday 9:30–10:00 Location: GÖR 226

CPP 111.1 Fri 9:30 GÖR 226

A Variational Perturbative Approach to Graph-based Multi-Agent Systems — •Dominik Linzner, Michael Schmidt, and Heinz Koeppl — TU Darmstadt, Germany

Understanding the behavior of multiple agents is a difficult task with numerous applications in the natural and social sciences. However, the number of possible configurations of such systems scales exponentially in the number of agents leaving many queries intractable – even if limiting interactions to a static interaction graph.

Variational approaches pave a principled way towards approximations of intractable distributions. Here, traditional approaches focus on directly constraining the class of variational distributions, e.g. in naïve mean-field statistical independence of all random variates is assumed. Variational perturbation theory (VPT) offers a different approach. Here, the similarity measure itself is approximated via a series expansion. A prominent example of this approach is Plefka's expansion [1,2]. The central assumption is that variables are only weakly coupled, i.e. the interaction of variables is scaled in some small perturbation parameter.

We derive a novel VPT for stochastic dynamics on static interaction graphs and use it to develop methods for different (inverse) problems such as system identification from data or optimal planning of coordination tasks.

[1] Plefka, T. (1982). Journal of Physics A, 15, 1971-1978. [2] Bachschmid-Romano et al. (2016). Journal of Physics A: Mathematical and Theoretical, 49(43), 434003-434033.

CPP 111.2 Fri 9:45 GÖR 226

A differentiable programming method for quantum control — •Frank Schäfer, Michal Kloc, Christoph Bruder, and Niels Lörch — Department of Physics, University of Basel, Klingelbergstrasse 82, CH-4056 Basel, Switzerland

Precise control of quantum systems is highly desirable in many current experimental setups and quantum information technologies. In quantum control, by optimization of control pulse sequences, protocols that maximize a case-specific figure of merit are obtained. To solve quantum state control problems, we treat (closed) quantum systems as differentiable programs. Within a framework that combines machine learning and the knowledge of the differential equations governing the dynamics of the physical system, we employ predictive models for optimal parameter estimation. We analyse the sensitivity of this approach against noise in the initial states and verify the robustness of the method.