Invitation to the Oral Examination – Department [CS / CE / EE / MATH]

For the occasion of his/her examination for a Doctoral Degree,

Konstantin Riedl

will present his/her dissertation entitled/on

Mathematical Foundations of Interacting Multi-Particle Systems for Optimization

on **24.09.2024** at **16:00 h**

Attendance to the presentation is open to the public. The presentation will be in English.

The candidate, all members of the Examination Committee, and authorized examiners of the TUM School of CIT are invited to the presentation and subsequent oral examination.

The presentation and subsequent examination will take place online via ZOOM:
https://tum-conf.zoom-x.de/j/65053540994?pwd=4nCnLC6LFWLfa0oqNUhQNfDMTvH4Y9.1

& in room **00.10.011**

Examination committee:

Chair: Prof. Dr. Gero Friesecke

First Examiner: Prof. Dr. Massimo Fornasier

Second Examiner: Prof. Dr. Michael Herty

Third Examiner: Prof. Dr. Nicolás García Trillos

Garching, the **11.09.2024**

Mailing list:

Members of the examination committee

Doctoral candidate

Abstract:

Interacting multi-particle systems are of paramount importance in and beyond applied mathematics, with far-reaching impact across a variety of scientific disciplines. This dissertation lays mathematical foundations for the numerical analysis of such systems in the setting of nonconvex nonsmooth optimization, itself a topic of fundamental interest throughout science and engineering. While systems of interacting particles are, due to their tremendous empirical success, broad spectrum of applicability, and ease of handling, widely used in practice, their rigorous theoretical analysis largely remained elusive. Given the necessity for capable, reliable, and robust algorithms that come with informative and solid convergence guarantees, a mathematical analysis framework for these methods is indispensable. We cover algorithms for classical global optimization problems in high dimensions as well as saddle point or so-called minimax problems. Our established analytical framework is flexible and versatile enough to be adapted to an even broader class of numerical methods. Furthermore, we discover a surprising, yet largely unexplored and unexploited link between the derivative-free and the gradient-based world in optimization. The central observations and core contributions of this dissertation build upon theoretical insights obtained by taking a mean-field perspective, which, by alleviating original complexities of the problem, allows us to understand, unveil, and distill the internal mechanisms responsible for empirically observed successes. These findings, moreover, enable us to go beyond the investigated large particle regime and infer properties of the associated interacting multi-agent systems of practical interest.