

# Numerical Analysis and Simulations of Mechanical Contact Problems

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**Abstract:** This dissertation focuses on numerical analysis and simulations of soft-body mechanical contact problems using the finite element method. It is an interdisciplinary study that combines computer science, applied mathematics, and solid mechanics. The main goal of this dissertation is to reduce the gap between the theoretical analysis of physical models and their practical implementations.

We present theoretical results in the field of contact mechanics based on a series of five academic articles published in international journals. In these articles, we focus on theoretical analysis of convergence and error of a discretized numerical scheme. We cover static, quasistatic, and dynamic models with various additional effects, such as temperature, wear of the material, and damage to the body.

We also introduce open-source software "Conmech3D", an important component of the study, which allowed us to perform simulations presented in the included papers. Our software provides GPU acceleration to increase simulation speed, simple numerical precision configuration, and automatic differentiation support. Using this software, we simulate concrete instances of abstract problems and empirically validate theoretical results.