Summary of the PhD thesis:
Study of a model for reference-free plasticity

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I study a Kac-type many particle model that allows a reference-free description of plastic deformation.In the framework of the model the state of the body is given by a set of atom position. The typical atom-atom distance is the microscopic scale. The size of the body is the macroscopic scale. Around each point a lattice is fitted to the configuration on a mesoscopic scale. The lattice parameters are used as an argument of a non-linear elasticity energy functional. Hence, this procedure allows to define an free-energy functional of a particle configuration.

In the first part of my thesis I analyze the model in the case that a reference configuration exists locally. I bound the energy-density of such a configuration from above with a pertubative calculation and obtain an upper bound for the energy barrier of plastic deformation for dimension two. In the second part I explore the possibility to construct Lagrangian coordinates in the framework of the model. I prove that for two points that are close to each other and that fulfill certain regularity assumptions the fitted lattice parameters are close to each other up to a reparametrisation. This allows to use discrete chains of regular points for homotopy type arguments and define a generalized Burgers vector as a topological quantity. Finally, I adapt a method to construct continuous Lagrangian coordinates presented in by L. Mugnai and S.Luckhaus to my model and improve it to a point where I can use a functional of these Lagrangian coordinate as a lower bound for the energy of the model.