ABSTRACT

Automated robot solutions have for decades been increasing productivity around the world. They are attractive for being fast, accurate and able to work in dangerous and repetitive environments. In traditional applications the grasped object is kinematically attached to the Tool Center Point and assumed to rigidly follow. For a broad range of objects, material and force combinations, the rigid assumption holds very well. The reason is that the size of deformations is often relatively small. However for some application use-cases, elastic properties of grasped objects cannot be ignored.

The purpose of this thesis is to address the modeling and simulation of deformable objects, as applied to robotic grasping and manipulation. The main contributions of this work are: An evaluation of 3D linear elasticity used for robot grasping as implemented by a Finite Difference Method supporting regular and adaptively refined grids, a stable and accurate non-linear 2D beam model supporting large deformations and difficult boundary effects, a method for the estimation of material properties and pose from depth and colour images, a method for the learning of Peg-in-Hole actions, an outline for Laying-Down actions as well a throughout evaluation of the accuracy of models under large deformations.