A Framework for Facilitating the Set-up of Industrial Pose Estimation Systems

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This thesis presents a framework for facilitating the setup of industrial pose estimation systems. Industrial applications often have low tolerances for accuracy and robustness, which makes the set up a complicated task. This setup procedure is further complicated by the current approach, where algorithms are created as universal methods for handling all use cases. To set up a new pose estimation for a specific application, therefore, requires a lot of modifications to the algorithm. During this thesis, it was found that the setup time resulting setup time hinders the use of pose estimation for agile production.

The proposed solution is to construct a framework of methods for tasks occurring in industrial settings. During this thesis, five methods for industrial pose estimation were developed. The methods cover different tasks in industrial pose estimation, and all show state-of-the-art performance. Additionally, the methods have a very short set up time.

The first method utilize 3D data to improve the robustness of 2D texture descriptors. The increased robustness allows the pose estimation system to operate accurately at increased perspective distortions.

Secondly, two methods have been designed to aid the tuning of pose estimation systems were only 3D data is present. One method uses Bayesian Optimization to select the best parameters for pose estimation in a specific setup, using very little training. The other method uses Deep Learning to learn direct point to point correspondence, showing even higher performance, but requiring more training data.

The fourth developed method focuses on situations where useful 3D data cannot be obtained. The method exploits inherent spatial constraints to obtain accurate pose estimation in 2D data. This system has shown much higher precision compared with other state-of-the-art methods. Additionally, the method was integrated with finger design for a complete object grasping pipeline. Finally, the developed pose estimation methodology was implemented successfully on a robotics platform performing various industrial tasks.

In this thesis, a new framework for pose estimation is presented. This framework consists of multiple solutions to industrial pose estimation tasks as opposed to modifying a single algorithm. The results show considerable improvements in both setup time and performance compared to current approaches.