Masterthesis

Image-based Quality control using Convolutional Neural Networks

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Abstract

The inspection of product quality is an integral part of a production process. For many applications, such as the production of parts and components for the automotive industries, a fast and robust automated quality visual inspection has received increasing attention in the product quality control. However, traditional automated optical inspection(AOI) based on machine vision is limited in defect detection due to two significant challenges: On the one hand, traditional approach is to use well-established computer vision techniques such as feature descriptors (SIFT, SURF, BRIEF, etc.) for object detection, which requires explicit engineered features, and feature extraction process is usually time-consuming. On the other hand, automatic defect localization is hard to be achieved by using traditional AOI, because the defects must be defined and adapted by the inspector. Recently, convolutional neural networks (CNN) have emerged as a powerful tool for many classification tasks. In this work, we firstly delved into CNN transfer learning techniques and investigated the feasibility of using pre-trained VGG-16 model for PEG(Polyethylene Glycol) defect detection. Then we proposed our CNN model named PEGNet, which achieves impressively high performance on the inspection of PEG dataset with an accuracy of 99.5%, while at the same time achieves defect regions localization by applying Gradient-weighted Class Activation Mapping (Grad-CAM) technique. All of the approaches including Halcon baseline method, fine-tuned VGG-16 method as well as our proposed method are evaluated on PEG dataset, and the experimental results demonstrate that the elaborately designed CNN model performs well on industrial PEG dataset.

Keywords: Product quality control • Machine Vision • Defect detection • Convolutional neural networks • Transfer learning • Binary Classification • Grad-CAM • Defect regions localization