TECHNISCHE HOCHSCHULE DEGGENDORF

AUTOMATIC PRODUCT CLASSIFICATION

CLASSIFICATION OF GOODS AND PRODUCTS IN E-COMMERCE USING MULTIPLE X-RAY PROJECTION IMAGES AND MACHINE LEARNING METHODS.

Weitere Infos

Automatic Product Classification

Introduction

There is a catch-up demand for automation in the processing of e-commerce shipping packages. This is being reinforced by the steady growth of online trading in Germany. Processes such as the classification of package contents could be automated when accepting returned packages. This project examines the use of industrial computed tomography (CT) in such an environment with the aim of classifying the contents of a package without opening it. Special attention was given to soft goods, especially clothes.

Methods

This project can be roughly divided into two sections: The creation of the data set and the training of neural networks. A data augmentation tool was developed especially for this kind of products, making it possible to create a representative data set with as few CT scans as possible. For this purpose, the three-dimensional CT data, is modified in the three-dimensional space, including elastic deformations, rotations, translations, and scaling of the soft goods. The position of all the voxels (three-dimensional pixels) is moved with a vector field. With this approach the layers of the clothing are not interrupted, but important features like buttons of a blouse or the zipper of a pair of jeans are locally shifted. Up to five clothing items in random combination are stacked on top of each other in random positions in a virtual packing process. The virtual packages modified in three-dimensional space were forward projected in a subsequent step. This allows the creation of two-dimensional projections from three-dimensional CT data. A set of up to 20 two-dimensional X-Ray projections of a packet from different angles is used as input to the neural network structure. To determine the classification and number of clothing items, a structure consisting of two parts is used. First, features of the data are extracted using a convolution-based neural network. The resulting feature vectors from the multiple projections are then analysed together with a recurrent neural network architecture. This network is based on the evaluation of time-distributed data, such as the recordings of the projections from constant different angles.

Results

By the used methods it is possible to determine the clothing items of a validation data set with a probability of up to 95% in the projection data. Furthermore, the influence of the number of used projections on the classification result is investigated. It can be shown that for this example the use of multiple projections is substantial for the improvement of the classification result. The collected results can be used for the planning of CT-systems, which are integrated in a conveyor chain.

Project Participants

Jochen Hiller has been Professor of X-ray Computed Tomography and Measurement Technology in the Faculty of Mechanical Engineering and Mechatronics at Deggendorf Institute of Technology DIT since 2014. His research focuses on accuracy improvement of CT measurements, image artefact reduction methods and robot-based CT.

Simon Wittl is a master's student in mechanical engineering at the Deggendorf University of Applied Sciences and is writing his master's thesis on the topic of object classification of e-commerce products on CT data using machine learning methods.