TUHH

Technische Universität Hamburg | W6 | 21079 Hamburg

Jiahua Wei
E-Mail: jiahua.wei@tuhh.de

Hamburg, 22.04.2023

Master-/ Project thesis at the Institute of Logistics Engineering

Title: Developing Physical Accurate Environmental Representations for Synthetic Data Generation in Computer Vision Testing

The commercial fruit cultivation field along the southern banks of the Elbe River in Hamburg and Lower Saxony is the second-largest contiguous fruit-growing area in Europe. In this context, the SAMSON Project was initialized to support farmers in the sustainable management of orchard areas through AI-powered automation systems.

One of the key objectives of the project is the automated detection of apples and blossoms to predict the yield after harvest. Data labeling for related supervised machine learning topics is crucial for model performance and accuracy, as it directly influences the quality of the training data. However, creating sophisticated labels is time-consuming and resource-intensive, requiring significant expertise and manual effort. A promising solution involves the use of synthetic data to create a virtual representation of the physical environment. This approach ensures that the position of each object is already known, which opens the potential to automatically annotate large amount of data.

To summarize: The main goal of this work is to investigate the potential of a physically accurate representation showcasing variety-specific apples on trees. In a subsequent phase, the self-annotated synthesized data will be employed to train object detection and tracking algorithms, which will then be compared with gathered field data from RGB-cameras.

Task definition:

- **State of the Art research:** Structural analysis of conventional apple trees and comparison of different 3D simulation and visualization software (Blender, Omniverse, Unity, SpeedTree)
- **Development of a simulation environment:** Design and implementation of a physical and textural accurate simulation environment that makes it possible to randomize the structure of a single tree and the position of the apples.
- **Data evaluation and analysis:** Collecting and analyzing data from field experiments as well as performance testing of Computer Vision Algorithms for synthetic generated data in direct comparison to physical captured data.

Requirements:

- Students of engineering or computer science
- Interest in simulation and machine learning
- Prior experience with simulation environments and digital twins is welcomed but not mandatory

Institut für Technische Logistik
Theodor-Yorck-Straße 8 | 21079 Hamburg
T. +49 40 428 78-3557
markus.knitt@tuhh.de
www.tuhh.de/itl