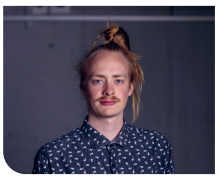
Volume and Weight Estimation using Monocular Vision in a Constrained Geometry

Feasibility Study

Graduate Candidates

Naoki Sean Pross



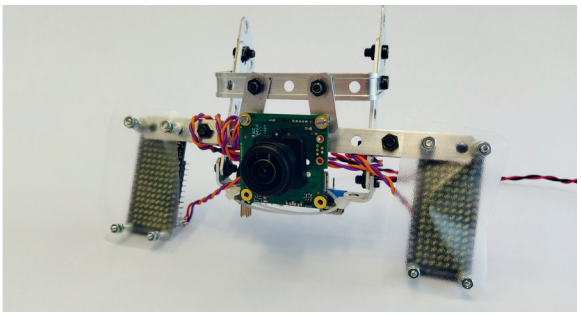
Tim Tönz

Introduction: This is a feasibility study in cooperation with an industry partner under a non-disclosure agreement, and will thus be discussed only in a conceptual manner. For optimization purposes the industry partner is interested in being able to know the weight of material that is processed in a machine. The task is to develop a system which estimates the weight based on an image taken by a single camera mounted to the machine.

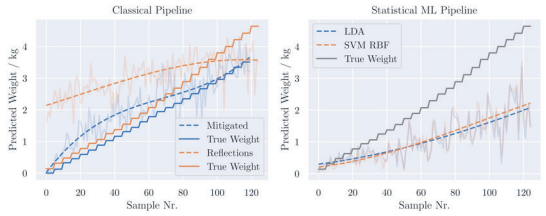
Approach: Evaluating various methods led to two solutions: an algorithm using only «classical» computer vision and a second method with statistical machine learning. The former can be summarized with the following steps. Given an image of a full machine, an image of the machine in the same position but empty is searched in a database. Both images are split into low resolution «tiles», and for each tile a set of statistical properties is computed. The statistical properties are stored as vectors and compared by measuring their Euclidean distance. The result is filtered, thresholded, and processed using morphological operations to obtain a binary mask. The binary mask indicates where in the machine there is material. From the area of this mask the weight of the material is estimated using an empirically determined function. The second algorithm uses statistical machine learning to remove the necessity of an image of the empty machine. Instead, a support vector machine classifies the tiles as containing material or not. The rest of the process is analogous to the classical approach.

Result: The performance of both algorithms was compared to measured data. The volume estimation is within the desired level of accuracy, but because of highly reflective chromed metal components in the machine the classical approach overestimates the weight. The ML method has the converse issue. Solutions to both problems are presented and discussed. However, because the material is highly compressible, in its current state the weight estimation yields only indicative values.

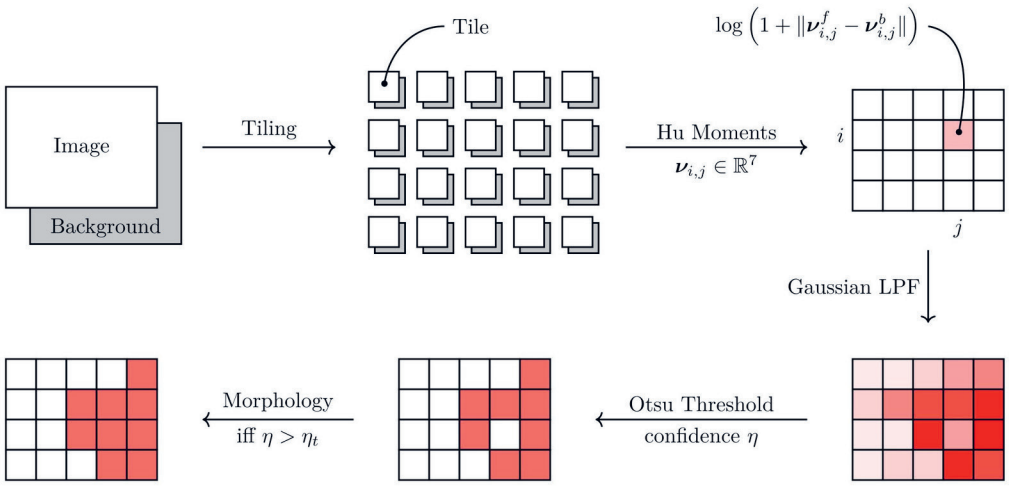
Measurement camera
Own presentment



Preliminary results
Own presentment



Classical image processing algorithm
Own presentment



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Subject Area
Image Processing and Computer Vision, Artificial Intelligence