Foreign object detection in multispectral X-ray images of food items using sparse discriminant analysis
Non-invasive food inspection and quality assurance are becoming viable techniques in food production due to the introduction of fast and accessible multispectral X-ray scanners. However, the novel devices produce massive amount of data and there is a need for fast and accurate algorithms for processing it. We apply a sparse classifier for foreign object detection and segmentation in multispectral X-ray. Using sparse methods makes it possible to potentially use fewer variables than traditional methods and thereby reduce acquisition time, data volume and classification speed. We report our results on two datasets with foreign objects, one set with spring rolls and one with minced meat. Our results indicate that it is possible to limit the amount of data stored to 50% of the original size without affecting classification accuracy of materials used for training. The method has attractive computational properties, which allows for fast classification of items in new images.

In-line 3D print failure detection using computer vision
Here we present our findings on a novel real-time vision system that allows for automatic detection of failure conditions that are considered outside of nominal operation. These failure modes include warping, build plate delamination and extrusion failure. Our system consists of a calibrated camera whose position and orientation is known in the machine coordinate system. We simulate what the object under print should look like for any given moment in time. This is compared to a segmentation of the current print, and statistical detection of significant deviation. We demonstrate that this methodology precisely and unambiguously detects the time point of print failure.
**Photogrammetry for Repositioning in Additive Manufacturing**

In this preliminary work, we present our current status on how to use single camera photogrammetry to determine the orientation of an additively manufactured partly finished object that has been repositioned in the printing chamber, from a single image taken with a calibrated camera, and comparing this to the CAD model of the object. We describe how this knowledge can be used to update the machine code of the printer such that printing of the object can be resumed in the new location. This opens possibilities for embedding and assembling foreign parts into the additive manufacturing pipeline, adding another layer of flexibility to the process. However, due to various errors sources in estimating the orientation of the object, more work is needed before this update can be applied.

**PicPrint: Embedding pictures in additive manufacturing**

Here we present PicPrint, a method and tool for producing an additively manufactured lithophane, enabling transferring and embedding 2D information into additively manufactured 3D objects. The method takes an input image and converts it to a corresponding height-map, indicating the material density required to achieve a brightness specified at any given location. Non-linear scattering properties are compensated for using predefined falloff profiles. Using the produced height-map, a watertight mesh is distorted to match the specified material densities, after which the mesh is ready for either direct print on an additive manufacturing system, or transfer to other geometries via Boolean mesh operations.
Projects:

The Statistics of Estimated Surfaces
Department of Applied Mathematics and Computer Science
Period: 01/01/2017 → 31/12/2019
Number of participants: 4
Phd Student:
Jensen, Janus Nørtoft (Intern)
Supervisor:
Bærentzen, Jakob Andreas (Intern)
De Chiffre, Leonardo (Intern)
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Aanæs, Henrik (Intern)

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Name of research programme: Institut stipendie (DTU)
Project: PhD