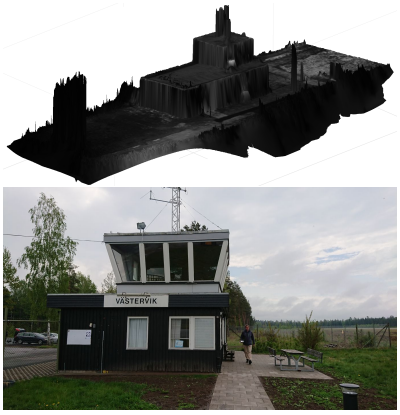
Hyperspectral 3D model for Material Analysis

Master's thesis Project Proposal



In a hyperspectral camera, each image line senses a slightly different wavelength from its neighbours. If the wavelength changes smoothly between neighbouring lines, a video from such a camera can be fed to a regular *structure from motion* (SfM) pipeline. This will register the frames into a camera pose graph, and a spectral signature for each part of the model can then be estimated by projecting the frames onto the model. A spectral signature can for instance indicate heat radiation, and small objects with certain spectral material characteristics, it also allows distinguishing between stains from body fluids and other substances. Per-point classification in the model is thus useful for analysis of buildings and crime scenes.

This project is a collaboration between Polisen, Spotscale AB and the Visual Sweden network for intelligent n-dimensional modelling. We are interested in obtaining an as-accurate-as-possible hyperspectral 3D model, and want to explore using side information in the form of a 3D model from a terrestrial laser scanner (a Lidar on a tripod). Hyperspectral frames can be registered to such a model using absolute camera pose estimation (solving the PnP problem). Datasets with both Lidar and hyperspectral data are available.

Tasks

1. Literature study absolute pose estimation, and spectral signature classification.
2. Use an existing SfM system (e.g. COLMAP) as a baseline and use it to register the hyperspectral video and obtain a 3D model. Also do PnP frame registration to an existing Lidar 3D model.
3. Generate the hyperspectral texture, and evaluate its quality, using e.g. MS-SSIM on the texture, reprojected in the input images.
4. Segment the model into different surface materials based on their spectral signatures.

Generated models can be visualized with e.g. MESHLAB.

Project Start

January 2020, or as agreed

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