Abstract
Simplified building models extraction from Ultra-light UAV Imagery

Olivier Küng[1,2], Christoph Strecha[1,2], Pascal Fua[1,2], Daniel Gurdan, Michael Achtelik, Klaus-Michael Doth, Jan Stumpf

Fully autonomous Micro Unmanned Aerial Vehicles (UAV) have recently become commercially available at very reasonable cost for civil applications. The advantages linked to their small mass is the ease of deployment and retrieval. Moreover, certain types of these UAV have the capabilities of taking oblique to horizontal imagery. In this paper we demonstrate a possible work-flow for extracting simplified building models out of oblique micro UAV imagery.

Traditional ground photogrammetry is a very involving process, as both image acquisition and post-processing require heavy manual intervention. The key element of simplified building models extraction is the automation of these steps and their seamless integration in a final manual refinement stage. Our study shows that combining an automated ultra-light UAV for easy image acquisition with mostly automated post-processing provides an convenient and affordable solution to produce 3D models of buildings.

In the frame of this paper, we present results using the AscTec Falcon 8 produced by Ascending Technologies GmbH (Ascending), an 8 rotors flying platform. Its camera records 10MP images. Due to the unique design of the AscTec Falcon 8 the camera is able to be faced completely down, horizontal and completely up without any of the rotors compromising the image. The image acquisition and post processing chain is composed of several steps:

1. A flight plan around the building for the Falcon 8 is automatically generated using Ascending's way-point planning software. After the flight, the images are geotagged using the GPS information of the flying platform in an automated process.
2. The images are the input of an automatic processing stage developed at EPFL-CVLab and commercialized by Pix4D[1]. It consists of an aerial triangulation algorithm based on binary local keypoints. Its output is the refined position and calibration for each image, together with a "sparse" cloud of points, composed only of 3D points from 2D keypoints extracted in the images.
3. The cloud of points is refined and made more dense by using multi-view stereoscopy techniques developed in the field of computer vision[2].

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[1] www.pix4d.com

[2] C. Strecha, W. von Hansen, L. Van Gool, P. Fua, U. Thoennessen "On Benchmarking Camera Calibration and Multi-View Stereo for High Resolution Imagery" CVPR 2008

4. A mesh is extracted from the cloud of points and then simplified in order to extract facades.
5. Finally, a manual refinement steps takes place with a seamless integration of the extracted facades and the cameras' position in an editing software such as Pointools[3] or Google Sketchup.

Acquisition of the images and post-processing steps 2 to 4 are fully automated and don't require any operator's time.

This paper is organized as follows. The first section provides an overview of existing Micro UAV for photogrammetry applications, focusing on the AscTec Falcon 8, which is best suited for building models extraction. Section 2 describes the whole processing chain that we applied in this paper. In Section 3 we present several datasets and demonstrate the simplified building extraction from the Micro UAV imagery. The result of one of the dataset is shown on Figures (1-4).

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[3] www.pointools.com

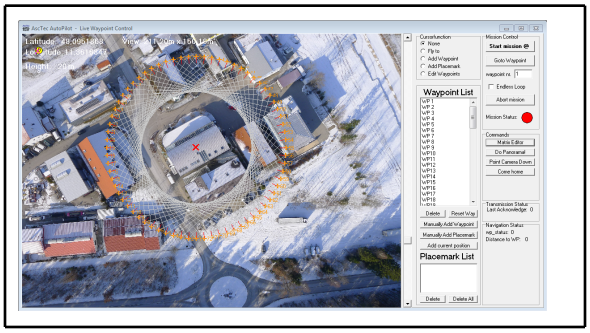

Figure 1: Flight plan of the AscTec Falcon 8


Figure 2: Images taken by the AscTec Falcon 8

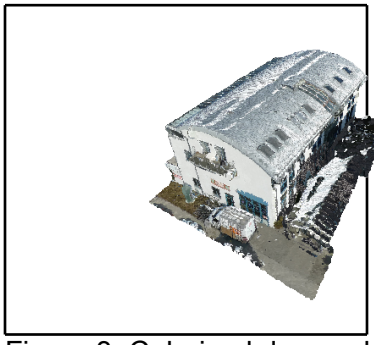
Figure 3: Colorized dense cloud of points

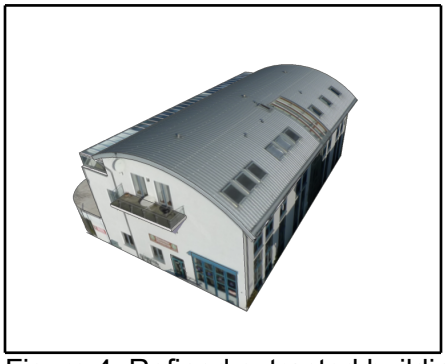
Figure 4: Refined extracted building models in Sketchup