

**Dense point cloud generation by automatic image matching from airborne imagery  
– Potential and challenges  
Finnish Remote Sensing Days**

**Eija Honkavaara<sup>(1)</sup>, Tomi Rosnell<sup>(1)</sup>**

*<sup>(1)</sup>Finnish Geodetic Institute  
Geodeetinrinne 2 02430 Masala, Finland*

Important recent cutting-edge advancement in the photogrammetric processing has been the comeback of image matching for surface point cloud generation [1,3]. Image based point clouds are an attracting alternative for laser scanning in many applications, especially if the surfaces are of interest. Laser scanner is still superior in vegetated areas in penetrating to the terrain surface and providing information of the vegetation structure. The image based point clouds can be utilized in similar manner as laser scanner based point clouds, or they can be utilized together with laser point clouds. Potential applications appear in many fields, such as mapping, city model generation, forestry, agriculture and disaster management.

In this presentation, we will describe the technology and present our recent results in dense image matching. In empirical investigations, images have been collected with manned and unmanned aerial vehicles (MAVs, UAVs), from different flying heights (100 – 4000 m), with different GSDs (2– 40 cm), of different objects (forests, built environment, agricultural areas), in different imaging conditions (winter, summer, spring; cloudy, sunny; different solar elevations) and using cameras varying from large format photogrammetric mapping cameras to compact consumer cameras. Typically, point clouds can be derived with point density corresponding to the GSD. The positional accuracy is dependent on the quality of the image block, and at best it is better than GSD. The detailed analysis of point clouds has shown that the point cloud quality is dependent on sensor quality, atmospheric state, illumination, shadows and object itself. [2, 4]

References

- [1] Haala, N. Comeback of Digital Image Matching. *Photogrammetric Week '09*; Fritch, D., Ed.; Wichmann Verlag: Heidelberg, Germany, 2009; pp. 289-301.
- [2] Honkavaara, E., Markelin, L., Rosnell, T., Nurminen, K., 2011b. Influence of solar elevation in radiometric and geometric performance of multispectral photogrammetry. *ISPRS Journal of Photogrammetry and Remote Sensing*. In press.
- [2] Leberl, F.; Irschara, A.; Pock, T.; Meixner, P.; Gruber, M.; Scholz, S.; Wiechert, A. Point clouds: Lidar versus 3D vision. *Photogrammetric Engineering & Remote Sensing* 2010, 76, 1123-1134.
- [4] Rosnell, T., Honkavaara, E., Nurminen, K., 2011b, On geometric processing of multi-temporal image data collected by light UAV systems. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, ISPRS ICWG I/V UAV-g (unmanned aerial vehicle in geomatics) conference, Zurich, Switzerland. 2011.*