Sfm_georef: Automating image measurement of ground control points for SfM-based projects

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Deriving accurate DEM and orthomosaic image products from UAV surveys generally involves the use of multiple ground control points (GCPs). Here, we demonstrate the automated collection of GCP image measurements for SfM-MVS processed projects, using sfm_georef software (James & Robson, 2012; http://www.lancaster.ac.uk/staff/jamesm/software/sfm_georef.htm). Sfm_georef was originally written to provide geo-referencing procedures for SfM-MVS projects. It has now been upgraded with a 3-D patch-based matching routine suitable for automating GCP image measurement in both aerial and ground-based (oblique) projects, with the aim of reducing the time required for accurate geo-referencing.

Sfm_georef is compatible with a range of SfM-MVS software and imports the relevant files that describe the image network, including camera models and tie points. 3-D survey measurements of ground control are then provided, either for natural features or artificial targets distributed over the project area. Automated GCP image measurement is manually initiated through identifying a GCP position in an image by mouse click; the GCP is then represented by a square planar patch in 3-D, textured from the image and oriented parallel to the local topographic surface (as defined by the 3-D positions of nearby tie points). Other images are then automatically examined by projecting the patch into the images (to account for differences in viewing geometry) and carrying out a sub-pixel normalised cross-correlation search in the local area. With two or more observations of a GCP, its 3-D co-ordinates are then derived by ray intersection. With the 3-D positions of three or more GCPs identified, an initial geo-referencing transform can be derived to relate the SfM-MVS co-ordinate system to that of the GCPs. Then, if GCPs are symmetric and identical, image texture from one representative GCP can be used to search automatically for all others throughout the image set. Finally, the GCP observations can be either used in sfm_georef to update the geo-referencing transform or can be exported for use in a bundle adjustment.

James & Robson (2012) Straightforward reconstruction of 3D surfaces and topography with a camera: Accuracy and geoscience application, J. Geophys. Res., 117, F03017, doi: 10.1029/2011JF002289.