Stakeout surveys for check dams in gullied areas by using the FreeXSap photogrammetric method

Carlos Castillo, Víctor Marín-Moreno, and Encarnación V. Taguas
University of Córdoba, Department of Rural Engineering, Córdoba, Spain

Prior to any check dam construction work, it is necessary to carry out field stakeout surveys to define the layout of the dam series according to spacing criteria. While in expensive and complex settings, accurate measurement techniques might be justified (e.g. differential GPS), for small to medium-sized check dams typical of areas affected by gully erosion, simpler methodologies might be more cost-efficient. Innovative 3D photogrammetric techniques based on Structure-from-Motion (SfM) algorithms have proved to be useful across different geomorphological applications and have been successfully applied for gully assessment.

In this communication, we present an efficient methodology consisting of the application of a free interface for photogrammetric reconstruction (FreeXSap) combined with simple distance measurements to obtain channel cross-sections determining the width and height of the check dam for a particular cross-section. We will illustrate its use for a hundred-meter-long gully under conventional agriculture in Córdoba (Spain).

FreeXSap is an easy-to-use graphical user interface written in Matlab Code (Mathworks, 2016) for the reconstruction of 3D models from image sets taken with digital consumer-grade cameras. The SfM algorithms are based on MicMac scripts (Pierrot-Deseilligny and Cléry, 2011) along with routines specifically developed for the orientation, determination and geometrical analysis of cross-sections. It only requires the collection of a few pictures of a channel cross-section (normally below 5) by the camera operator to build an accurate 3D model, while a second operator holds a pole in vertical position (with the help of a bubble level attached to the pole) in order to provide orientation and scale for further processing. The spacing between check dams was determined using the head-to-toe rule by using a clinometer App on a Smartphone.

In this work we will evaluate the results of the application of this methodology in terms of time and cost requirements and the capabilities and operation procedure of FreeXSap will be presented. This tool will be available for free download.

REFERENCES

Pierrot-Deseilligny, M and Cléry, I. APERO, an Open Source Bundle Adjusment Software for Automatic Calibration and Orientation of a Set of Images. Proceedings of the ISPRS Commission V Symposium, Image Engineering and Vision Metrology, Trento, Italy, 2-4 March 2011.