3D image data integration for advanced Cultural Heritage documentation

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For many Cultural Heritage (CH) documentation projects it is of advantage to use sensors of different type or mounted on different platforms. In the documentation and modeling of large buildings, sets of images are usually taken from the ground level to capture detailed façade information and intruding or extruding features while airborne (nadiral and oblique views) images enable not only to capture the roof structures, but also to see the surrounding of the building in a larger spatial context and to observe façade details.

As far as spectral information is concerned, state-of-the-art high resolution RGB sensors are good to represent the visual spectrum, and thanks to their high resolution they allow to derive accurate 3D information, given the images are taken in a well-designed configuration. Other sensors, like near infrared cameras, thermo-, or hyperspectral cameras etc. do usually not have a spatial resolution as good as RGB cameras, but they provide valuable information for further data interpretation and object analysis in the CH context.

Any application making use of this kind of data or derived products, would benefit if all sensor data is integrated in an homogeneous manner, which means not only spatial (i.e. a proper geometric) co-registration but also in terms of spectral information.

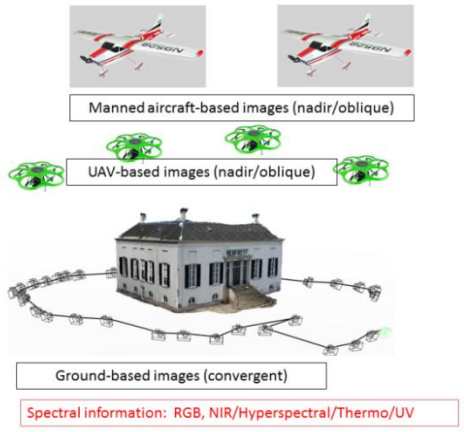

Figure 1. Sketch showing CH building, input data and platforms for sensor integration.

The presented work describes the preliminary results achieved by the authors during the first part of the Short Term Scientific Mission (STSM) in the COSCH project framework.

The STSM work aim at investigating the integration of heterogeneous image data in the same reference system and the extraction of interest features for CH applications. The integration of terrestrial and aerial RGB images as well as the integration of multi-spectral images (RGB + thermal images) are considered to define the best practices to be adopted in the CH domain.

The STSM project can be divided in four different parts:

1) Multi-camera RGB images orientation;
2) Multi-spectral images co-registration;
3) Point cloud generation, filtering and meshing;
4) Feature extraction from 2D and 3D data.

In the presentation the results achieved in the first part of the work will be shown. A description of the already existing methods for the integration of heterogeneous images will be firstly presented to show the state of the art in this field.

Then, the achieved results of part 1 and 2 of the presented project will be shown.

The automated orientation of images acquired from different cameras and very different points of view (aerial and terrestrial) will be given: academic and commercial packages have been considered for this topic to define the more reliable and user-friendly solution (e.g. Apero, PhotoScan, etc.). The simultaneous orientation in a reference system with a minimum number of Ground Control Points (GCP) or approximate GNSS information from UAV systems has been evaluated too.

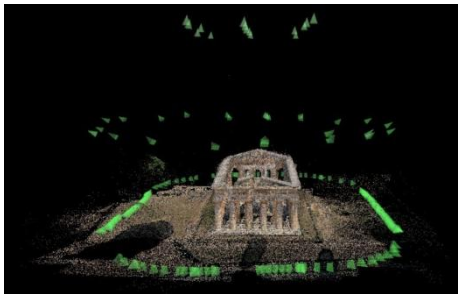

Figure 2. Orientation of terrestrial and UAV images (Paestum temple, Italy).

Finally, the first results concerning the integration between RGB and thermal images will be shown. Several interest operators will be tested and adapted to succeed in the registration of this kind of data: the reliability and the accuracy of this co-registration process in practical applications will be discussed in detail.

The future developments and improvements of the STSM (such as the 3D point cloud generation, meshing and the feature extraction) will be outlined and discussed too.