After the success of the past editions, the Italian Society of Photogrammetry and Topography (SIFET) is proposing a 2019 edition of the Benchmark, this edition is focused on the issues connected with the survey of a submerged archaeological site. The achievement of underwater surveys requires different techniques with respect to the terrestrial survey, also due to the fact that the application of active range-based sensors, e.g. like laser scanners, is nowadays still under development, especially for sites of large dimensions. Multi-image photogrammetry is thus the most used technique for the survey of submerged sites, thanks to its ability to integrate rapidity of deployment, good metric accuracy and overall affordability. The photogrammetric approach has replaced the traditional direct survey technique performed through trilateration, a technique that is today still used to measure the Ground Control Points (GCPs) and obtain their coordinates, in order to georeference and scale the 3D model.

The development of low-cost and open-source software solutions, together with the enhancement of feature extraction and image matching algorithms, has transformed photogrammetry from a complex, expensive and time-consuming procedure to a low-cost and rapid technique. Moreover, the diffusion of this methodology in the field of underwater surveying is also related with the constant growth of the availability on the market of low-cost commercial cameras and waterproof cases.

Nevertheless, different issues are still unsolved in the field of underwater photogrammetry, e.g. the measurement phase of GCPs, that is still performed with the direct trilateration and the calibration of employed camera. In particular, camera calibration, that can be considered an almost solved issue in terrestrial applications, is still a crucial point in underwater photogrammetry, where the lens distortions are increased from the presence of the water and the waterproof case, both generating different distortion on the path of the projective rays. Furthermore, the variability of the water properties needs to be considered as well: density, temperature, pressure and salinity are all factors that can influence the refraction index. Finally, the visibility conditions are another factor than need to be considered when working underwater: they are linked with the presence of suspended fine materials and with the decreasing of light in connection to the growth of depth and the differences in the wavelength absorption.

Universities, research centres, professionals and companies are invited to take part in this shared experience, enrolling freely to the “SIFET Benchmark 2019”, downloading the data and processing them by whatever digital photogrammetric software they prefer.
The Dataset
The dataset provided is the outcome of a survey conducted on a Roman site where different marble items are present on the seabed (three columns, three squared blocks and four irregular blocks) in an area of 18x10 m and between 5 and 7 metres of depth. The photogrammetric acquisitions were achieved following this scheme: 9 nadiral stripes and two radial acquisitions around the blocks in order to better record also their vertical development. A Nikon D700 equipped with a fixed 20 mm lens and inserted in a waterproof case with a hemispherical dome was used to perform the acquisitions. Due to the difficulty on maintaining a static position during the diving phase it was necessary to set up the ISO value to 1600 during the acquisition phase; this set up led to a higher noise in the acquired images in comparison with traditional terrestrial acquisitions. In order to remove the blue dominant, typical of underwater acquired images, a white balance was performed using a medium-grey colour control card.

How to participate
The application form (www.sifet.org) has to be fill out and signed, and after that, it is necessary to send it to sifetbenchmark@gmail.com. Each participant will receive a link to download the dataset, composed of the following files:

<table>
<thead>
<tr>
<th>ID</th>
<th>dataset</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Images</td>
<td>323 images (221 nadiral e 102 radial) of the site</td>
</tr>
<tr>
<td>2</td>
<td>Coordinates</td>
<td>Coordinates of 5 target positioned on the blocks</td>
</tr>
<tr>
<td>3</td>
<td>Sketch</td>
<td>Sketch of the marble blocks with the positioning of GCPs (red) and of the checkpoints, which coordinates won’t be communicated (blue)</td>
</tr>
</tbody>
</table>

The aim of this Benchmark is not to achieve the “best possible results” in an absolute sense, but to experiment different possible processing modalities of a dataset acquired with a specific system available on the market, aiming at reaching the “best possible results” in a relative sense.

Participants can use any Structure from Motion (SfM) photogrammetric software, e.g. Agisoft PhotoScan, PhotoModeler, Pix4D Mapper, 3DF Zephyr Aerial (licensed software), Autodesk Recap Pro (free software with cloud computing), Apero, Bundler, MicMac, VisualSFM (open source software) to complete the data processing. They can also vary the number of images used to retrieve the photogrammetric model or, eventually, work on the radiometric correction of the images. The required products are the following: sparse cloud extraction, georeferencing on the model on the provided GCPs, dense cloud generation following the Dense Image Matching (DIM) approach, generation of the Digital Surface Model (DSM) and extraction of an orthophoto, as will be specified hereafter.

Submission of results/output within May 12th, 2019

Participants should prepare the following “results packages” (file format and other details are reported in the application form):

1. Estimated parameters of image calibration
2. Coordinates obtained from images of the checkpoints, as specified in the provided sketch
3. Dense point cloud
4. 1:20 scale plan, in form of digital orthophoto
5. DEM, following the provided indications
6. Section of the model, as indicated in the application form
Participants can test and compare all the software at their disposal, however they can send only up to two “results packages”, justifying their decision. A report is thus required, where the used software, the hardware characteristics and all the processing performed, the various computational times, the accomplished comparisons and the quality assessments carried out will be described. The files contained in the “results packages” need to be properly named.

Participants have to communicate the total size (MB) of their result to sifetbenchmark@gmail.com, afterwards they will receive instructions on how to submit the results before 12th of May.

The SIFET BM2017 working group will compare the results and products submitted.

**Presentation and open discussion on the results in SIFET 2019 National Congress in Venezia**

In the final session of the SIFET National Conference in Venezia, results will be presented and discussed: SIFET Benchmark 2019, thanks to the participation of experts (from professional and scientific community) will highlight potentialities and challenges of this image-based technique allowing, first of all, to generate geo-referenced dense points clouds and orthophotos of underwater scenarios.

SIFET BM2017 working group:
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