TEST-FIELD FOR EVALUATION OF LABORATORY CRATERS USING INTERPOLATION-BASED CRATER DETECTION ALGORITHM AND COMPARISON WITH MARTIAN IMPACT CRATERS.

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Summary: Test-field for evaluation of laboratory craters was developed. This includes 3D scanning, emplacement in MOLA and LOLA data, evaluation using interpolation-based crater detection algorithm, and comparison with Martian impact craters.

Introduction: The objective of this work is to provide a simple cost-effective method for creation and evaluation of laboratory craters in order to provide a straightforward way for studying real impact craters on diverse planetary bodies. In our previous work the following has been provided: **(1)** crater detection algorithm (CDA) and MA115225GT catalog [1]; **(2)** comparison of depth/diameter ratios [2, 3] between our explosion-induced laboratory craters in stone powder surfaces, craters available in MA115225GT [4], small fresh Martian craters [5], explosive cratering under a large range of gravities simulated in a centrifuge [6], etc.; **(3)** interpolation-based improvements of our CDA [7]; **(4)** CDA-based method for objective estimation of the level of achieved similarity between laboratory and real impact craters [8]; **(5)** method for 3D scanning of laboratory craters in order to produce a high-accuracy digital topography of their shape [9], and **(6)** MA130301GT catalog which in combination with 1/128° MOLA data provides so far the most complete set of 3D-shapes of Martian craters that can be compared with laboratory craters [10].

Methods: The developed methods are as follows:

Emplacement of laboratory craters in topography of planetary body. This method has been developed in order to emplace 3D-scans of laboratory crater at any location of Martian, Lunar, or any other planetary body. The objective for emplacement is to provide a smooth transition between surrounding topography and laboratory crater, and at the same time to preserve a topography of laboratory crater. The device GOM-ATOS-I, used for digitizing the craters, projects structured light patterns onto the surface of the object and captures the image using two CCD cameras.

Execution of CDA. We used four different CDAs (Canny and Shen-Castan based without [1] and with [7] interpolation-based improvements) for two different planetary objects (Mars and Moon). The objective is to test robustness of the approach.

Evaluation of CDA's results. Using ROC' curve [10] it is possible to define the measure of similarity between laboratory and real impact craters, as TDR or FDR value, or as a distance from the bottom-right origin of the ROC' curve [8]. The objective is to provide a reproducible (formally described) method for evaluation of laboratory craters.

Extraction of profiles. In the first step, the CDA [7] detections were manually corrected (location, diameter) in order to be aligned with emplaced laboratory craters. In the second step, the same CDA [7] was used to produce 2D profiles of laboratory craters, as well as profiles of selected Martian craters.

Results: In this work, we: **(1)** created 3D scans of seven laboratory craters produced by detonation of cylindrically shaped Ag_2C_2 charges ignited with a laser; **(2)** embedded them into Martian 1/128° MOLA and Lunar 1/128° LOLA data; **(3)** used our previous [1] and new [7] CDAs in order to test detectability of laboratory craters and to produce 2D profiles; **(4)** compared these seven laboratory craters with 2D profiles of ~40 smaller (several kilometers in size) Martian craters that exhibit the highest depth/diameter ratio (signature of their relatively young age), available in MA130301GT [10].

Conclusion: As shown in Fig. 1, the overall test-field for evaluation of laboratory craters is robust and functions well for topographies of two different planetary bodies, four different CDAs, and scans of seven different laboratory craters. In addition, despite being only a few centimeters across these laboratory craters are similar to Martian craters of several kilometers in size. Depth/diameter ratios and slopes of laboratory craters are slightly larger than Martian, what corresponds to freshly created still no-eroded craters, and follow the trend of vertically larger explosive charges producing: (1) deeper craters, and (2) craters with steeper walls. The reliability of the experimental setup is demonstrated by reproducibility of experiments where explosive charges of similar shapes produced similar craters (only one out of seven craters fails to follow the trend).

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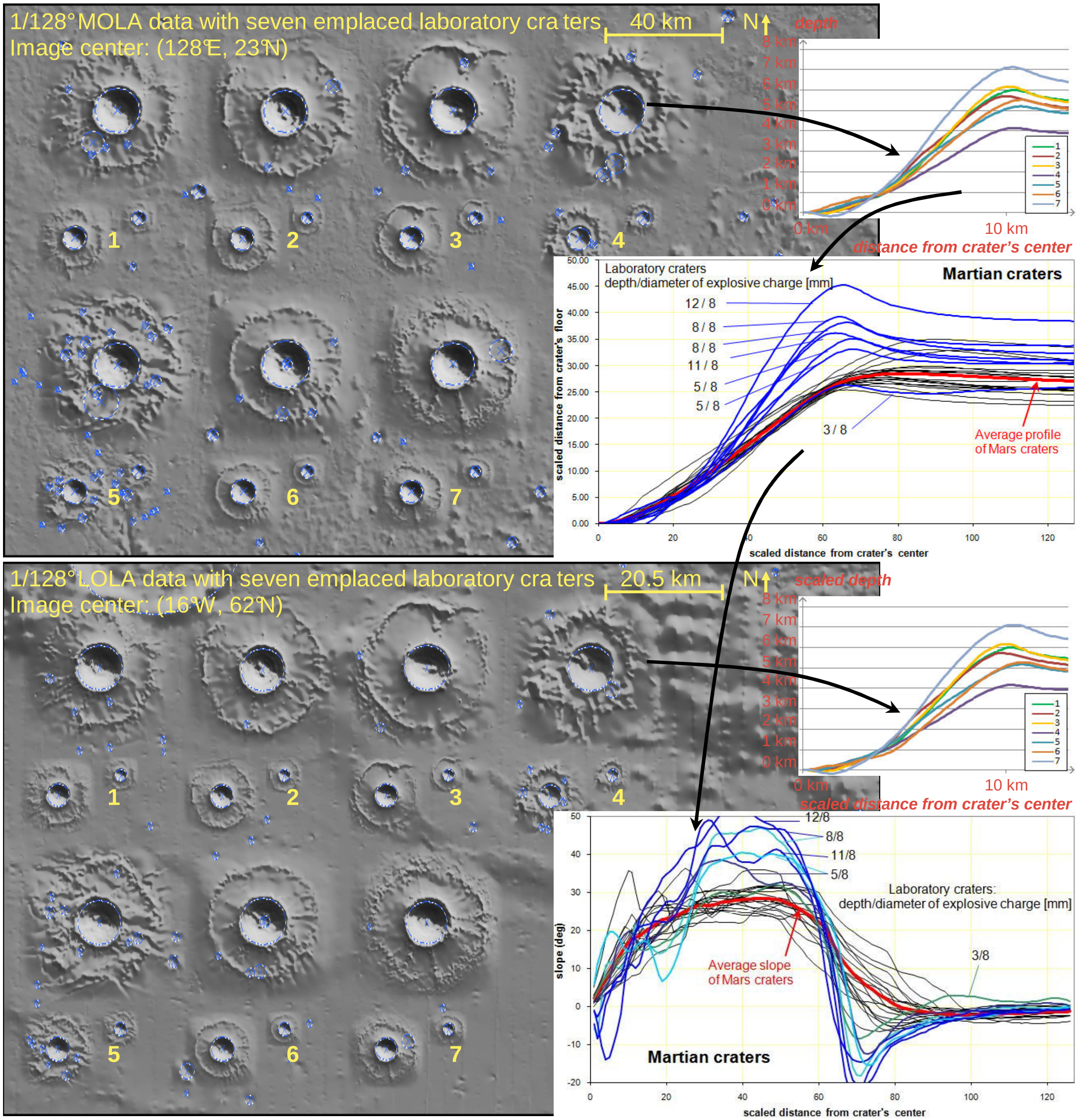

Figure 1: Test-field for evaluation of laboratory craters wherein seven of them were embedded (in three different sizes) in Martian 1/128° MOLA (top) and Lunar 1/128° LOLA (bottom) data and successfully detected by our CDA. The corresponding profiles are as well created by our CDA (top-right frames on both images). The comparison with Martian craters using corresponding profiles and their slopes is shown in two bottom-right frames.