MACHINE DETECTION AND GLOBAL CATALOG OF PHOBOS CRATERS. G. Salamunićcar[1,2], S. Lončarić[2], P. Pina[3], L. Bandeira[3,4], and J. Saraiva[3,5], [1]AVL-AST d.o.o., Av. Dubrovnik 10/II, HR-10020 Zagreb-Novi Zagreb, Croatia, gsc@ieee.org, [2]Faculty of Electrical Engineering and Computing, University of Zagreb, Unska 3, HR-10000 Zagreb, Croatia, sven.loncaric@fer.hr, [3]Instituto Superior Técnico/Centro de Recursos Naturais e Ambiente (IST/CERENA), Universidade Técnica de Lisboa, 1049-001 Lisboa, Portugal, ppina@ist.utl.pt, [4]lpcbandeira@ist.utl.pt, [5]jose.saraiva@ist.utl.pt.

Summary: Newly released topographic image atlas of Phobos was processed with our DEM-based and optical-based crater detection algorithms. The result is a new catalogue of 504 Phobos impact craters.

Introduction: The volume of acquired data increases significantly with each new planetary mission. In lunar and planetary science, some of the most studied features are impact craters. This justifies the expectations that crater detection algorithms (CDAs) will play an important role in methods of processing and interpreting large amounts of data. An overview of 112 CDA-related publications from numerous authors is given in two recent papers [1, 2]. The capability of processing global datasets for a complete lunar or planetary body has so far been demonstrated by only three DEM-based CDAs [3, 4, 5], and the capability of constructing global catalogues as well by only two [4, 5]. In recent work on one of the largest catalogues of Martian impact craters MA130301GT [2], we used CDAs developed in our previous work [5, 6] and improved evaluation methodologies [2] in comparison with the initial version [1], particularly the advanced crater registration. There is only one more complete catalogue which contains 288 993 craters [7]. In this work, we used our DEM-based [5, 8] and optical-based CDAs [6], together with previously developed methodology [2], in order to create the first global catalogue of Phobos craters.

Datasets and Methods: Used datasets and developed methods are as follows:

Datasets: We used newly released topographic image atlas of Phobos [9], including global DEM upsampled in 1/4° resolution and global optical image mosaic in 1/16° resolution.

Re-projection of datasets and craters' coordinates. We used this method to convert the entire DEM and optical global datasets, including crater locations, so that the geographical North and South Poles are rotated on the equator of the new coordinate system. With such an approach, we provided systematic processing of the entire planetary body.

Crater detection algorithms. In the first step, we used our DEM-based CDA in combination with Phobos 1/4° DEM. Used interpolation-based CDA is based on previous work [5], and relies on a specially developed interpolation method [8], which is suitable for detection of small craters. In the second step, we used our optical-based CDA [6] in combination with Phobos optical datasets, in resolutions 1/4° (downsampled from 1/8°), 1/8° (downsampled from 1/16°) and 1/16°.

Automated tiles generation and import of results. For optical-based CDA, tiles were generated [2] with 512x512 pixels each, and with an overlap of 25% between adjacent tiles. Tiles were generated for latitude ranges of 64°N~63.75°S (for 1/4°), 56°N~55.875°S (for 1/8°), 52°N~51.9375°S (for 1/16°), in order to cover the complete planetary body by our processing. The resulting crater-candidates were imported using the same methodology from previous work [2].

Manual verification of crater-candidates. Each crater-candidate is either (as described in recent work [2]): (1) rejected; or (2) corrected (coordinates and diameter) before inclusion into the catalogue.

Results: As shown in Fig. 1, DEM-based CDA [5, 8] successfully detected all larger impact craters, resulting in the initial catalogue of 47 largest craters. Four named craters not covered in this step, and available on maps from [9], were added manually. As shown in Fig. 2, optical-based CDA [6] successfully detected 453 additional craters, resulting in the new catalogue of 504 Phobos impact craters (PH504GT).

Conclusion: Phobos, a small asteroid-like moon presented a challenge for CDAs previously developed for Mars. This led to larger number of false detections than in previous work. Despite these problems, our CDAs were used successfully for cataloguing Phobos craters, the subject of the only previous work on CDAs for detection of craters on asteroids [10].

References: [1] Salamunićcar G. and Lončarić S. (2008) *Adv. Space Res.*, *42*, 6-19. [2] Salamunićcar G. et al. (2011) *Planet. and Space Sci.*, *59*, 111-131. [3] Michael G. G. (2003) *Planet. and Space Sci.*, *51*, 563-568. [4] Stepinski T. F. and Urbach E. R. (2008) *11th Mars Crater Consortium meeting*, Abstract #3. [5] Salamunićcar G. and Lončarić S. (2010) *Trans. Geosci. Remote Sens.*, *48*, 2317-2329. [6] Bandeira L. et al. (2007) *Trans. Geosci. Remote Sens.*, *45*, 4008-4015. [7] Robbins S. J. and Hynek B. M. (2010) *LPS XLI*, Abstract #2257. [8] Salamunićcar G. and Lončarić S. (2010) *COSPAR 38*, Abstract #B02-0042-10. [9] Wählisch M. et al. (2010) *Earth and Planet. Sci. Lett.*, *294*, 547-553. [10] Leroy B. et al. (2001) *Image and Vision Comp.*, *19*, 787-792.

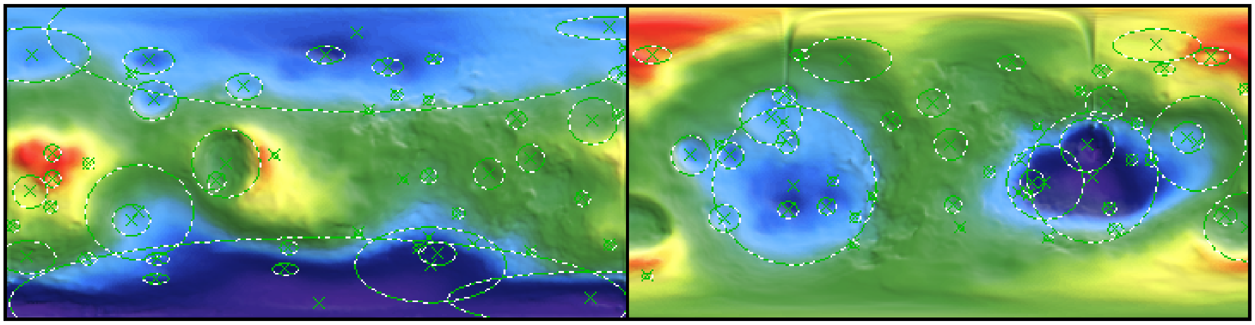

Figure 1: Standard (right) and rotated (left) view of 1/4° Phobos DEM and the processed output of our DEM-based CDA [5, 8]. In addition to 47 accepted crater-candidates we added 4 named craters manually.

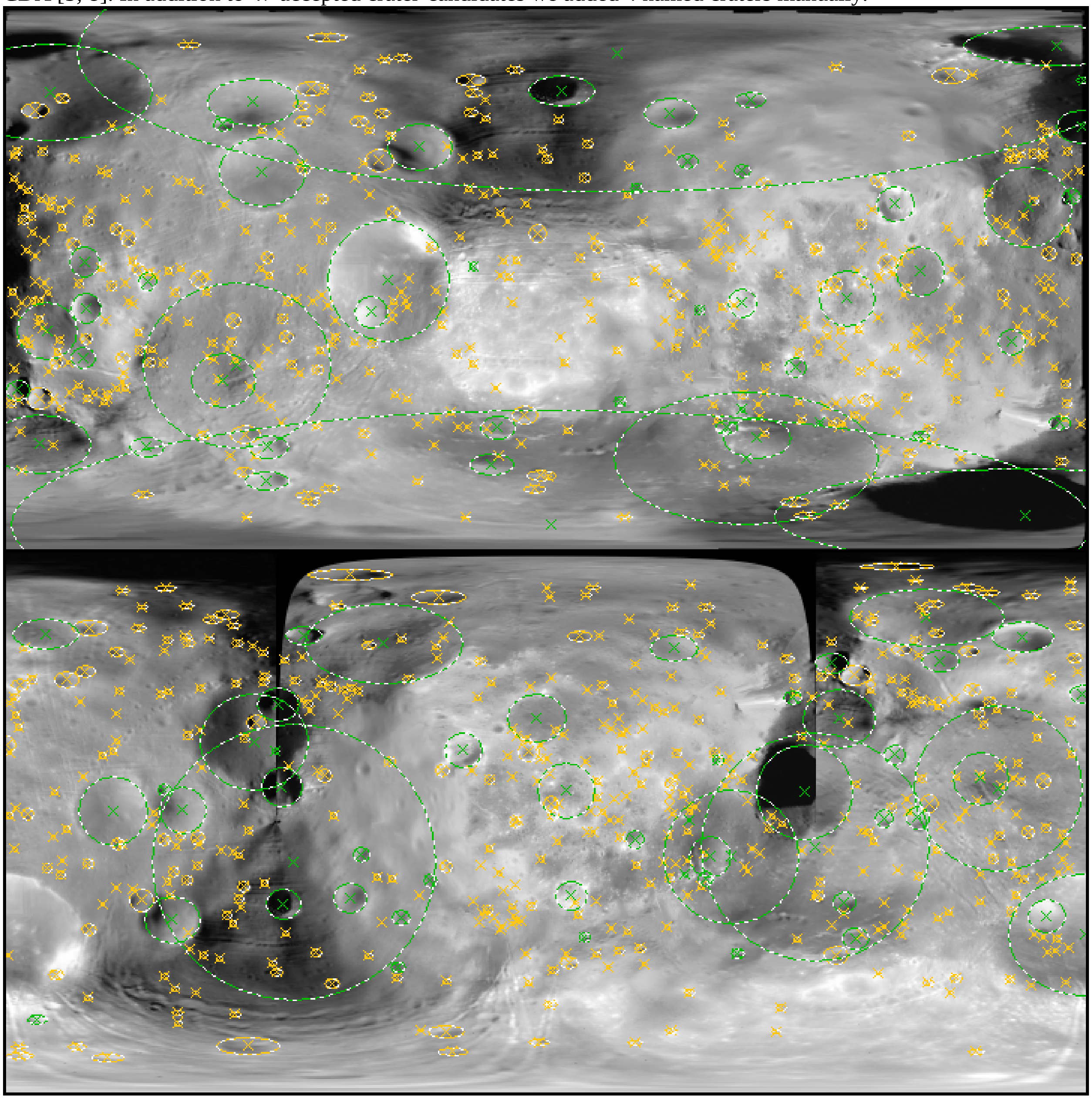

Figure 2: Standard (top) and rotated (bottom) view of 1/16° Phobos optical global image mosaic and the processed output of our optical-based CDA [6]. In addition to previous 51 craters (green), there are 453 new entries (yellow). The resulting global catalogue of Phobos craters (PH504GT) contains 504 (15 named) craters.