TOPOGRAPHY PROFILE DIAGRAMS OF MARS: ALGORITHMS FOR COMPUTING ALTITUDE OF CRATERS. Z. Nežić[1] and G. Salamunićcar[2], [1]PELSYS d.o.o., Ivana Lučića 5, 10000 Zagreb, Croatia, Europe, Zdravko.Nezic@ieee.org, [2]AVL-AST d.o.o., Av. Dubrovnik 10/II, 10020 Zagreb, Croatia, Europe, gsc@ieee.org.

Introduction: Recently, mathematical approach was proposed [1] providing a way to compute how deep Martian ocean was during each period of the planet history, including the probability that ocean existed once. An important step toward the formal proof of Martian ocean recession, timing and probability is representation of Martian topography and related values, in the form of topography profile diagrams. For this purpose, algorithms for computing crater altitude according to the topography, center coordinates and radius of impact crater r are of importance.

Density of craters curve: Range from *0%* to *100%* in x direction is divided into 256 equal intervals. Each one corresponds to altitude range from the topography profile curve. Values in y direction are normalized according to the maximal one. Altitude of each impact crater corresponds then to exactly one such range. Therefore, Y value of each point on this curve is than the number of craters associated to the corresponding range. However, the question is what the altitude of a crater is. If we just define the altitude of some crater as the altitude of its center (Fig. 1 case 0), we will not have an altitude of the planet surface at this point before the impact, but will include the error proportional with the crater size. This would lead in the final curve to the shift toward left, as shown in Fig. 2 for case 0.

The maximal value inside the crater: Result for taking the maximal value of all points inside the crater for crater altitude (Fig. 1 case 1) is shown in Fig. 2 as case 1. At least some of those points are very close to the actual altitude before the impact, particularly those nearby crater border. This approach partially solved the problem and was used in [1], however later study showed that there are also many disadvantages. The biggest problems are the protrusion of crater rim over surrounding terrain and sensitivity to noise. The higher the resolution MOLA topography map is used, the larger is the discrepancy. This is especially undesirable, because other computations require higher resolution to achieve better precision. The influence of those problems can best be viewed as the appearance of local minimum between the first and the second (last) local maximum. On higher altitudes we have less smooth surface and so the larger noise, leading to the larger shift to right resulting in this local minimum.

Average value with weight factor: As shown in Fig. 2 as case 2, average value was computed for all points using weight factors 3, 2 and 1 (Fig. 1 case 2) for $d < r$, $r < d < 2r$, and $2r < d < 3r$ respectively (d is the distance from the center of the crater). The influence of noise is so compensated, while the problem from the initial case is also partially avoided as well. Taking points closer to the center with higher weight factor makes the computed value better approximation to the altitude of the center, however for the same reason as in the initial case, this results in a shift to the left.

Average value without weight factor: In cases 3 to 8 as shown in Fig. 2 and Fig. 3, average value was computed for points where: $d < r$, $d < 2r$, $d < 3r$, $r < d < 2r$, $r < d < 3r$ and $2r < d < 3r$ (Fig. 1 cases 3-8). Best approximation is the case where $r < d < 2r$. However, even in this case as in all other cases where mean value of large number of points is computed, we have shift of craters on very low altitudes to the right, and on very high altitudes to the left.

Mean value of four points: In cases 9, 10 and 11 shown in Fig. 3, the mean value is computed out of 4 opposite points (Fig. 1 cases 9-11). In case 9 the points are (r, 0), ($-r$, 0), (0, r) and (0, $-r$), in case 10 ($2r$, 0), ($-2r$, 0), (0, $2r$) and (0, $-2r$), and in case 11 ($3r$, 0), ($-3r$, 0), (0, $3r$) and (0, $-3r$).

Conclusion: Computing mean value of only four points almost completely avoids shift inherent in cases based on average value. There is no noise like in the case 1, while we also avoided taking altitude of the center as the value. Case 10, which is the most accurate approximation of the surface altitude before the impact, is in use in the present, and will be in the future work until some better algorithm is proposed.

References: [1] Salamunićcar G. (2002) *COSPAR 34*, Abstract #01766.

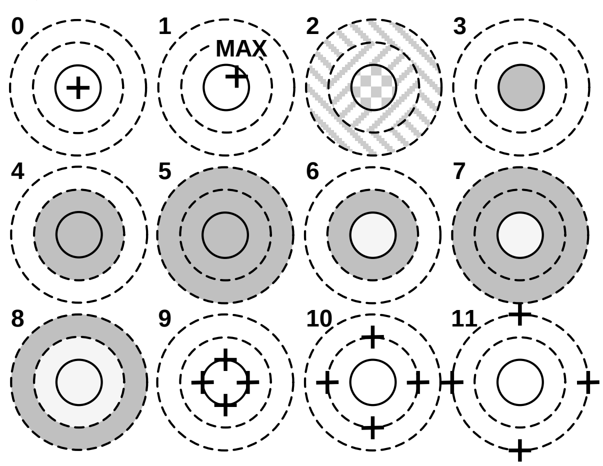

Figure 1: Graphical representation of algorithm cases 0, 1, 2, 3-8 and 9-11.

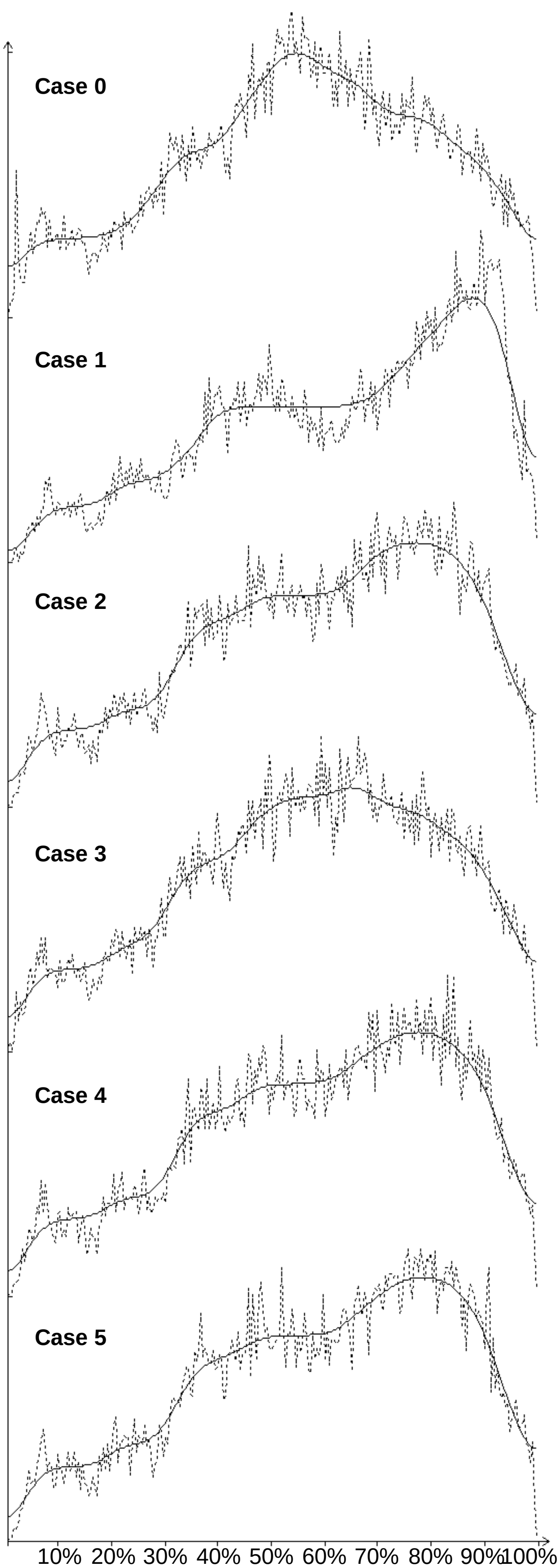

Figure 2: Crater density curves for cases 0 to 5.

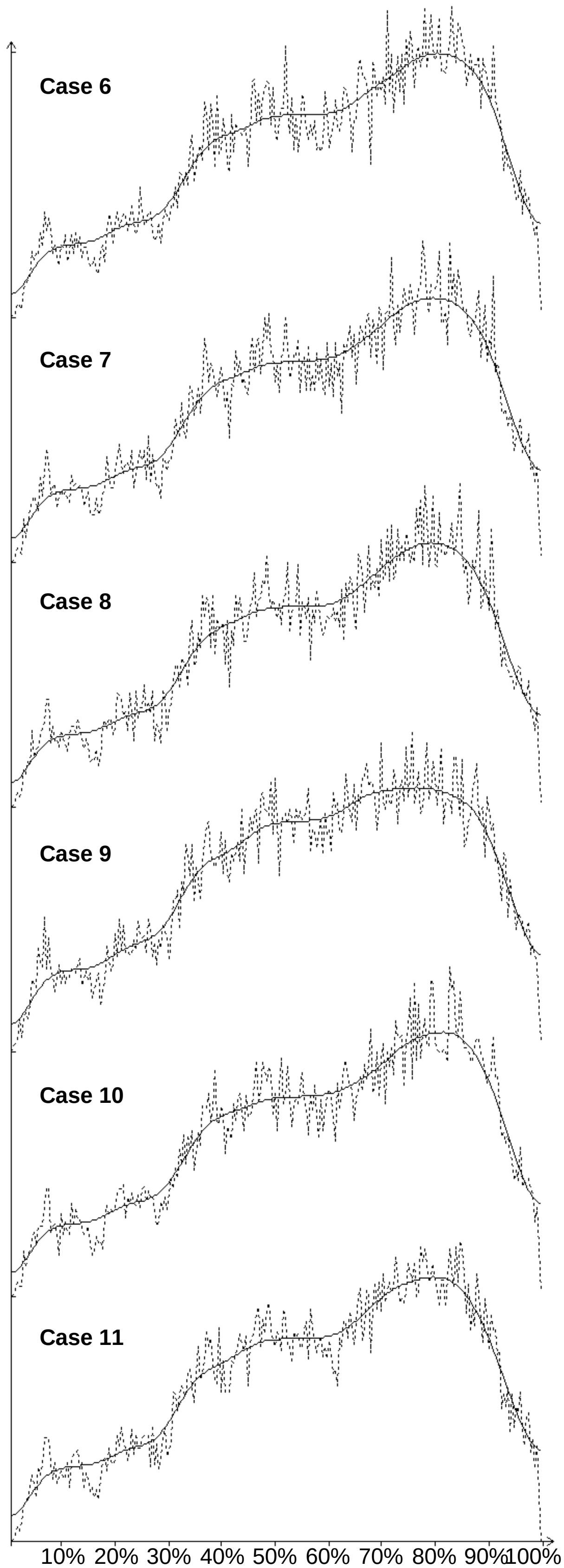

Figure 3: Crater density curves for cases 6 to 11.