TOPOGRAPHY PROFILE DIAGRAMS OF MARS: ARCHITECTURE OF THE DENSITY OF CRATERS CURVE LOW-PASS FILTER. 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. 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, the architecture of the crater density curve low-pass filter is important.

Block-diagram: In Fig. 1, block diagram of the low-pass filter is shown, and in Fig. 2 and Fig. 3, results of filtering for data-sets with 9496 and 22044 craters. For *DCC* (Density-of-Craters Curve), the altitude of crater is defined as the middle value of points (*2r*, *0*), (*-2r*, *0*), (*0*, *2r*) and (*0*, *-2r*), where *r* is the radius of impact crater. The whole range of altitudes is divided into *n=256* intervals.

Filling low-pass shift filter: The primary purpose of this filter is to fill the local gaps, which are consequence of noise. From *DCC* we can see that basically we have one minimum at the beginning and one at the end of the curve, and one maximum between (we can always check the original signal to see if this is the case). Accordingly, the filter is designed to "fill the gaps" while there are more than those three local extremes. In all odd passes, it process the signal from left to right, and in all even passes, from right to left, to avoid global shift to the left or to the right.

Gradient low-pass shift filter: The primary purpose of this filter is to ensure that maximal gradient is not higher than some limit, which was particularly of help when smaller number of craters and less advanced algorithm for computing altitude of each crater were used. In Fig. 1 and Fig. 2 for the first two cases, we have maximal gradient defined as 1 and 10 respectively, while plateau and ordinary filters were excluded.

Plateau low-pass shift filter: The beginning of *LSOTC* (Level-of-Substance-Over-Time Curve) is defined as the point where *FDCC* (Filtered *DCC*) falls on 90% of its maximal value. Any noise and/or local fluctuations around the local maximum directly influence precision of those, as well as of some other computations. To avoid this problem, this filter was included, and between 0% and 49% the percentage of the plateau around local maximum can be defined if we are not interested in local fluctuations of the *FDCC*. In Fig. 1 and Fig. 2 for cases 3 and 4, we have the same parameters as for the cases 1 and 2, but with inclusion of this filter set up to plateau of 25%.

Ordinary low-pass filter: The main purpose of this filter is to additionally eliminate high frequencies. In Fig. 1 and Fig. 2 for cases 5 and 6, we have the same parameters as for the cases 3 and 4, but with the included ordinary low-pass filter set up to *strength* 99%. Details of the filter are given in Fig. 4 and Eq. (1) - (4).

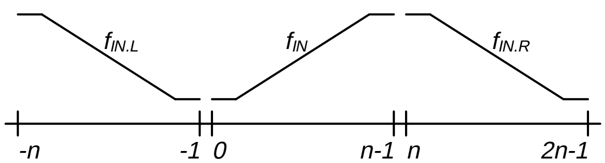

Figure 4: Function extension to avoid low-pass filter caused distortion near the edges of the function.

$$factor = \sqrt{-\ln \frac{strength}{100}} \tag{1}$$

$$f_{OUT}(k) = \sum_{j=-n}^{2n-1} f_{IN}(j) \cdot e^{-\left[(j-k)\cdot factor\right]^2} \tag{2}$$

$$f_{IN.L}(j) = f_{IN}(-j-1) \quad \forall j < 0 \tag{3}$$

$$f_{IN.R}(j) = f_{IN}(-j+2n-1) \quad \forall j > n-1 \tag{4}$$

Conclusion: In the previous work [1], parameters (25%, 1, 99%) were used, but now, when data-set with 22044 craters and better algorithm for computing altitude of crater are available, parameters (25%, 10, 99%) are better choice. This is the most accurate smooth approximation of the original *DCC*, as we can see for the last case in Fig. 1 and Fig 2.

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

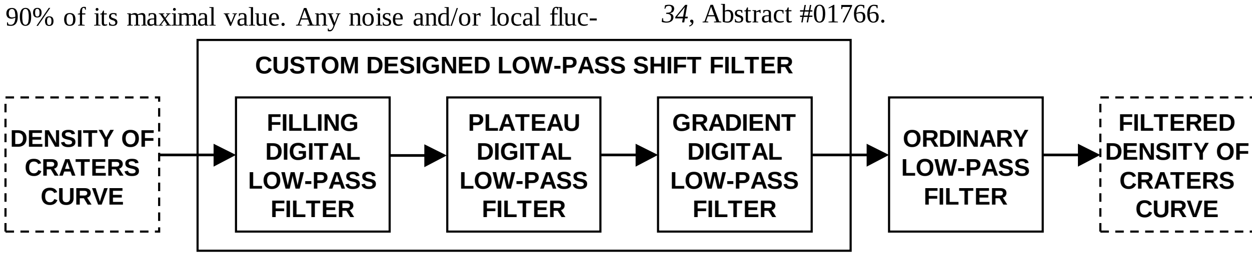

Figure 1: Block-diagram of the custom designed low-pass filter for filtering the density of craters curve.

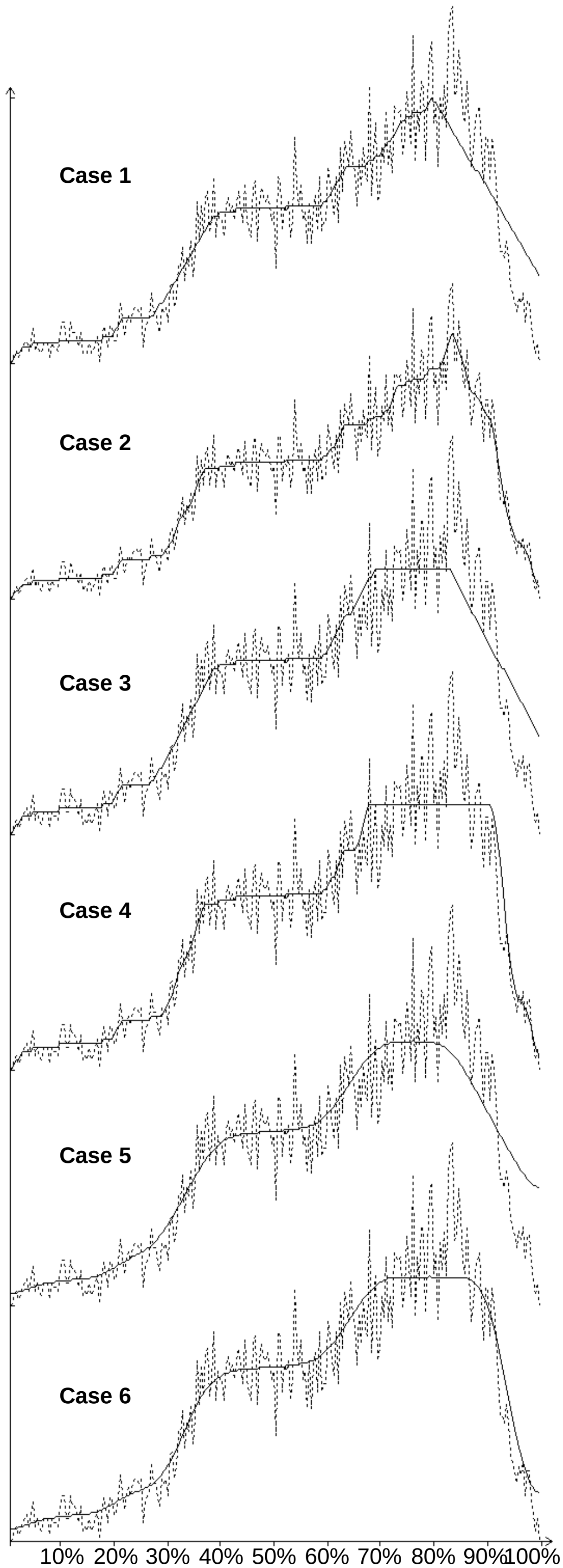

Figure 2: Low-pass filter cases for 9496 craters.

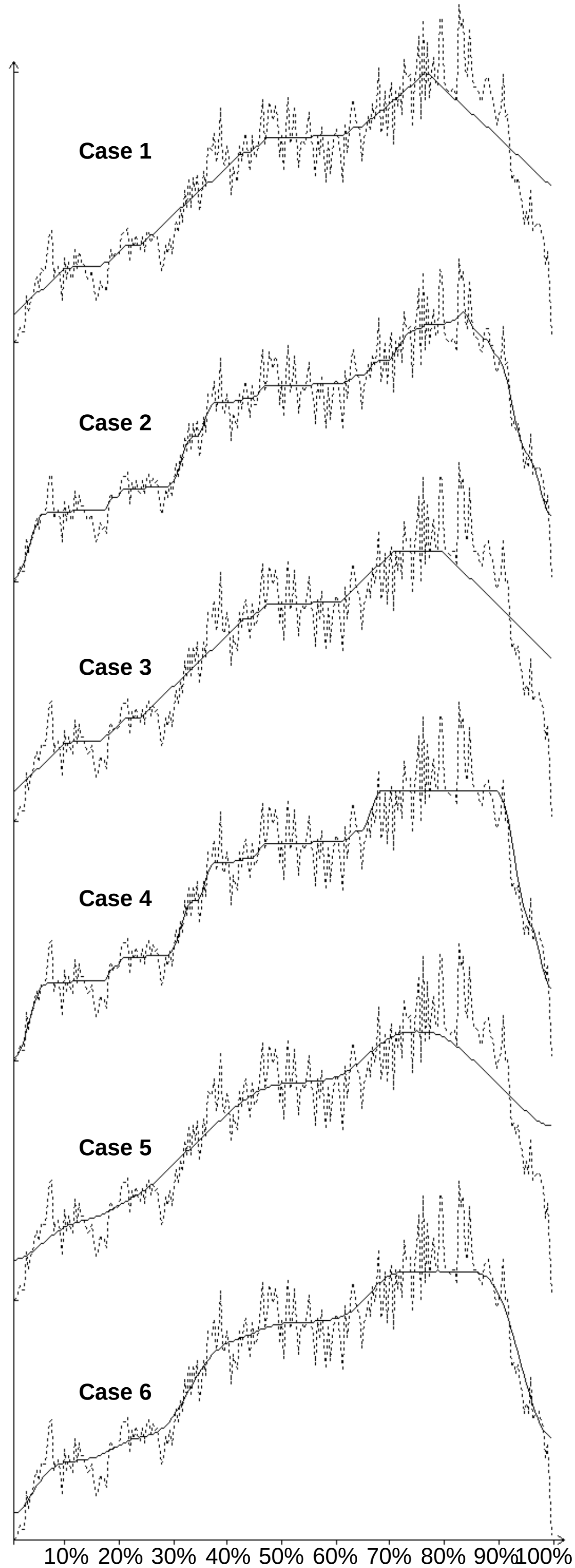

Figure 3: Low-pass filter cases for 22044 craters.