

## Multiscale Feature-Preserving Smoothing of Tomographic Data

Feature Size	Volume Size		
	100 <sup>3</sup>	256 <sup>3</sup>	300 <sup>3</sup>
5 <sup>3</sup>	41sec	430sec	730sec
10 <sup>3</sup>	41sec	650sec	730sec
15 <sup>3</sup>	41sec	750sec	800sec

**Table 1:** Kernel computation time (in sec) for various volume size at different feature size

Diffusion Step	Volume Size		
	100 <sup>3</sup>	256 <sup>3</sup>	300 <sup>3</sup>
1 step	0.2sec	4.79sec	6.61sec
50 step	0.42sec	10sec	14sec

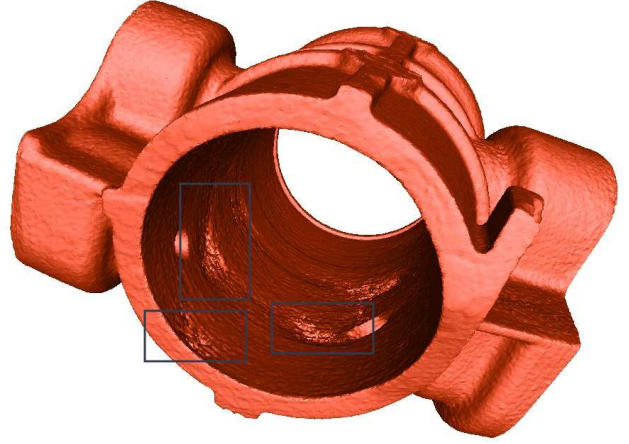
**Table 2:** Time (in sec) for computing 1 and 50 diffusion steps for various volume size

Table 1 shows the time in seconds for computing the kernel of volumes of size 100<sup>3</sup>, 256<sup>3</sup>, and 300<sup>3</sup>. The kernel is computed at different feature size. A volume of size 300<sup>3</sup> at feature size 10<sup>3</sup> takes around 730sec to compute its kernel. Table 2 shows the time in seconds executing 1 and 50 diffusion steps of different volume sizes. A volume of size 300<sup>3</sup> needs 6.61 to execute one diffusion step.

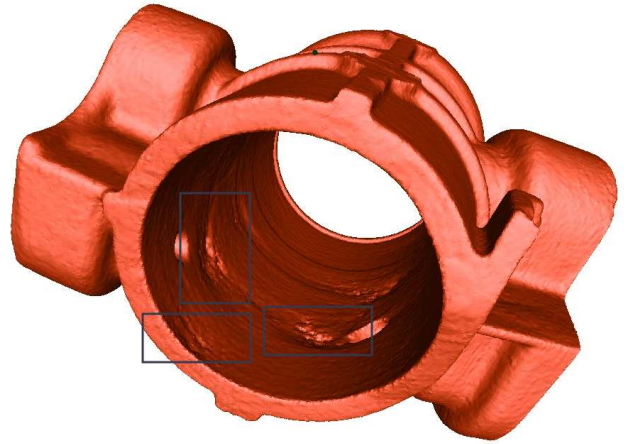
Fig. 1 shows a mechanical tool that was extracted from a 300<sup>3</sup> volume. The contour surface extracted is noisy and contains very high topological genus, small handles and holes. After smoothing the volume with our technique; shown in Fig. 2, the surface is clean and the noise was removed while preserving small features such as sharp edges. Furthermore, one can notice the holes inside the object have been removed.

Fig. 3 shows an inhaler that was extracted from a 256<sup>3</sup> volume. As one can see, we can hardly distinguish between the details and features of the object from the noise and very high topological genus. After smoothing the volume with our technique; shown in Fig. 4, the surface is clean while preserving the features and details such as sharp edges. One can now easily distinguish between the features. Furthermore, notice how the sharp edges have been maintained and other parts of the object repaired with respect to its original noisy extracted surface.

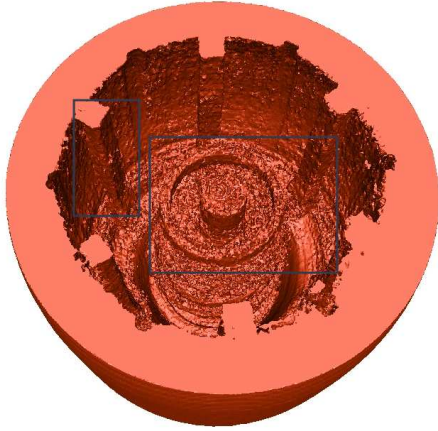
Our technique can also clean geological tomographic data. Fig. 5 shows a contour of a geological surface. It is full of topological genus. This can clearly be seen from an inside view of the model shown in Fig. 7. Fig. 6 shows the volume cleaned after running our technique on it while preserving the details and features. An inside view (Fig. 8 of the smoothed model shows a clean surface as it removes the noise and repaired the surface. It has become much pleasant for the eye to look at.



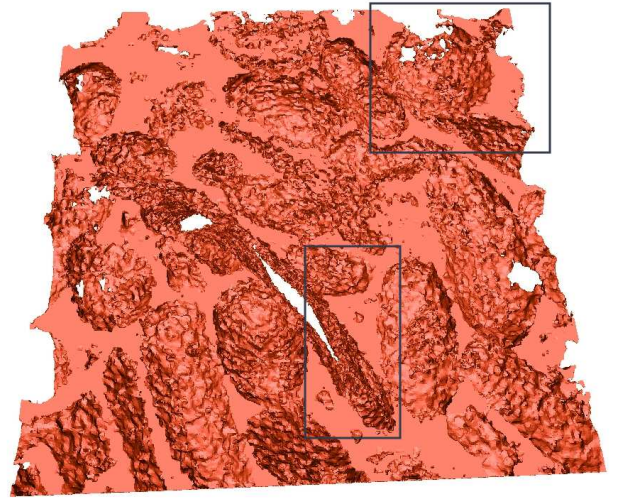
**Figure 1:** A contour surface extracted noisy from tomographic data displays many artifacts: surface noise including regions of locally very high topological genus, small handles and holes.



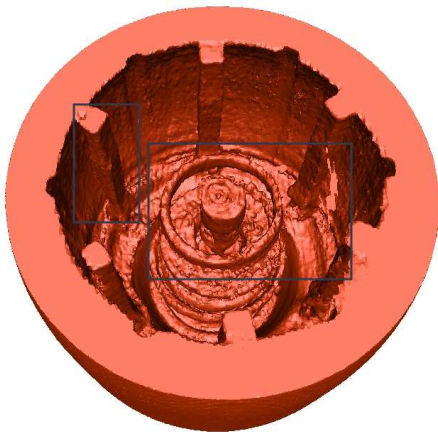
**Figure 2:** After smoothing the volume (Fig. 1) with our technique, the surface is clean, and the noise was removed while preserving small features such as sharp edges.



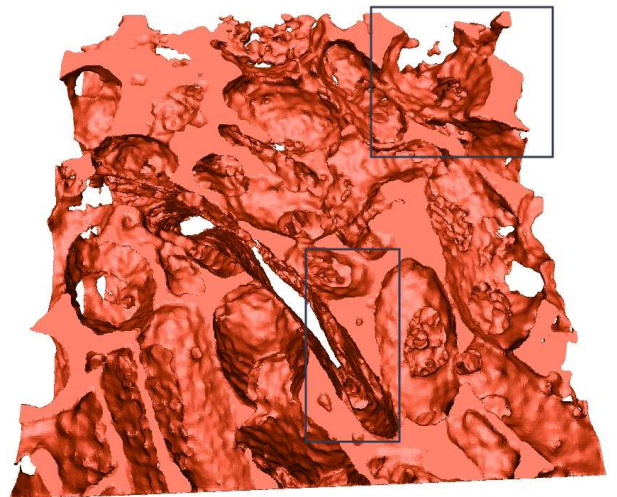
**Figure 3:** A contour surface extracted noisy from tomographic data displays many artifacts. The noise makes it hard to distinguish the features of the object.



**Figure 5:** A contour surface extracted noisy from a geological tomographic data displays many artifacts including regions of very high topological genus.

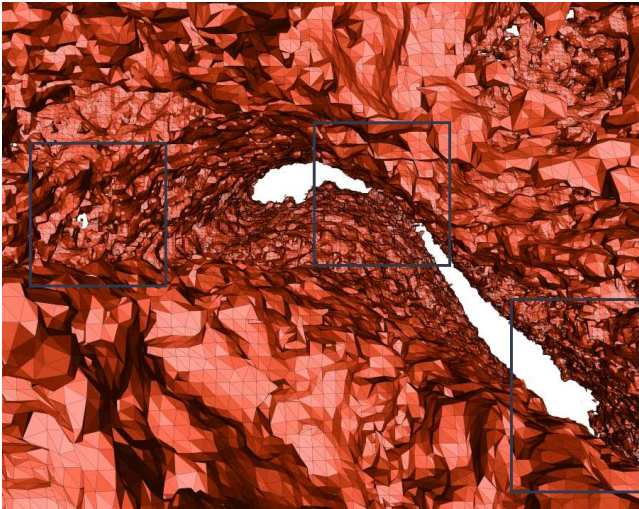


**Figure 4:** After smoothing the volume (Fig. 3) with our technique, the surface is clean, and the noise was removed while preserving small features and sharp edges. The object is much more recognizable as an inhaler.

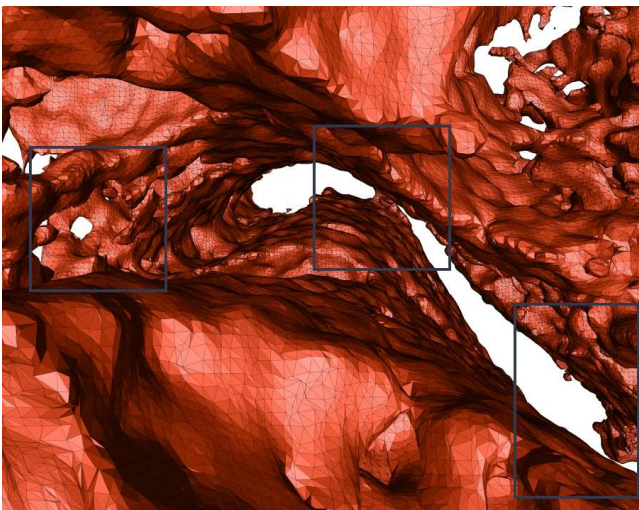


**Figure 6:** After smoothing the volume (Fig. 5) with our technique, the surface is clean, the noise was removed, and the surface was repaired while preserving small features and sharp edges. The geological model can be better viewed and analyzed.





**Figure 7:** An inside view of the geological contour surface extracted in Fig. 5. The present high topological genus makes hard to make sense of what is seen.



**Figure 8:** An inside of view of the clean volume in Fig. 6. Notice how the noise and topological genus have been removed. It has become much pleasant for the eye to analyze.