Regularization of Voxel Art

Supplementary material: Additional results and comparisons

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Figure 1: Regularization on higher resolution voxel shapes: Buddha and Dragon in a $256^3$ domain.

Figure 2: Multi-labeled image with four shapes ($75^3$) (a). In (b) and (c) the regularization obtained by our approach ($\alpha = 10^{-3}$, $\beta = 1$ and $\gamma = 10^{-1}$). In (d) we have the interfaces obtained using a volumetric tetrahedrization from [AJR+17].

References


Figure 3: Various voxel art regularization results. First row, a $50^3$ ball and a $45^3$ voxel scene with very thin structures. Second row: $25 \times 20 \times 65$ volume with 2 regions, one for the helmet glass and one for the rest. Third row: $127^3$ volume with four regions: the sea, the ship, the cloud and the island. All experiments have been obtained with the same parameters ($\alpha = 10^{-3}$, $\beta = 1$ and $\gamma = 10^{-4}$). Voxel artwork courtesy of Elbriga (https://twitter.com/gabriel_d_L) and Mike Judge (https://github.com/mikelovesrobots/mmmm).

Figure 4: Voxel upscaling using a voxelization of the regularized objects: (left) from $75^3$ to $512^3$. (right) Upscaling to $256^3$ and $512^3$ from the Bunny object in $64^3$ and its regularized surface (in blue).
Figure 5: Comparisons on a voxel shape with both sharp and smooth features at three different resolutions: $10^3$, $20^3$ and $40^3$. For the last two columns (our results), we have used the same weights for all shapes ($\alpha = 10^{-3}$, $\beta = 1$ and $\gamma = 10^{-1}$).

Figure 6: Numerical instability of DC when using a robust normal vector field from [CFGL16] (same as the one in Fig. 8-(d)) but with positions still located in-between adjacent voxels.
Figure 7: Stability of our method with respect to perturbations in the input normal vector field (40° shape, same α, β and γ parameters): (a) the regularization with the input normal vector field from [CFGL16], (b) random shifts $\epsilon$ with $\|\epsilon\| < 0.2$ (up to 11°), (c) with $\|\epsilon\| < 0.5$ (up to 26.5°), and (d) with $\|\epsilon\| < 0.8$ (up to 38.7°). For the second row, we have used the default parameters ($\alpha = 10^{-3}, \beta = 1, \gamma = 10^{-1}$). For the third row, we have reduced the alignment term ($\beta = 10^{-1}$) to handle the strong noise (only for (c) and (d)).

Figure 8: Regularization for various normal vector estimators: (a) trivial normal vectors, (b) isotropic integral invariant estimator [CLL14], (c) robust anisotropic voting based normal vectors [BM12], and (d) piecewise smooth anisotropic normal vectors [CFGL16].