Title

3D Well-composed Polyhedral Complexes

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Abstract

This demo has been developed to show the algorithm and data structures presented in the paper *3D Well-composed Polyhedral Complexes*, accepted for publication in Discrete Applied Mathematics (preprint available at arXiv:1403.2980[cs.CV]). A method is described there to locally "repair" the cubical complex $Q(I)$ (embedded in $\mathbb{R}^3$) associated to a binary three-dimensional (3D) image I to obtain a polyhedral complex $P(I)$ homotopy equivalent to $Q(I)$ such that the boundary surface of $P(I)$ is a 2D manifold (and, hence, $P(I)$ is a well-composed polyhedral complex). For this aim, we develope a new codification system for a complex K, called Extended-CubeMap (ECM) representation of K, that codifies: (1) the information of the cells of K (including geometric information), under the form of a 3D grayscale image; and (2) the boundary face relations between the cells of K. The procedure described is accomplished on the ECM representation E_Q of the cubical complex $Q(I)$ to obtain an ECM representation E_P of a well-composed polyhedral complex $P(I)$ that is homotopy equivalent to $Q(I)$. This procedure is based on some "color-changing" operations around critical vertices of E_Q, which correspond to points on which the boundary surface of the geometric cubical complex fail to be a 2D manifold.

This way, the input of the software is a txt file storing the coordinates in $\mathbb{Z}^3$ of the points of the image I. First, it generates the cubical complex associated to the image $Q(I)$ and the ECM representation for $Q(I)$, E_Q. It detects the critical vertices in E_Q and applies three neighbourhood color operations around the critical vertices to yield a new 3D grayscale image E_P which is the repaired ECM representation. Finally, the polyhedral complex $P(I)$ that is represented by E_P can also be computed and visualized.

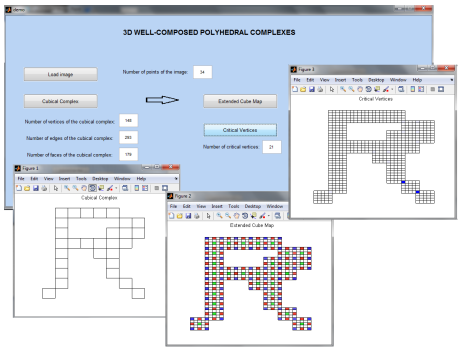

Figure 1: Cubical Complex $Q(I)$, ECM of $Q(I)$ and critical vertices.

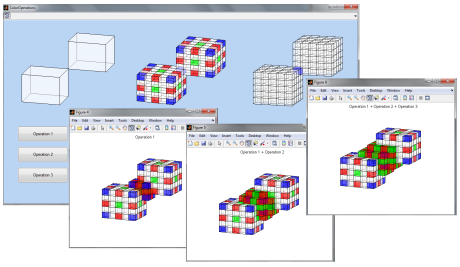

Figure 2: Color Operations.

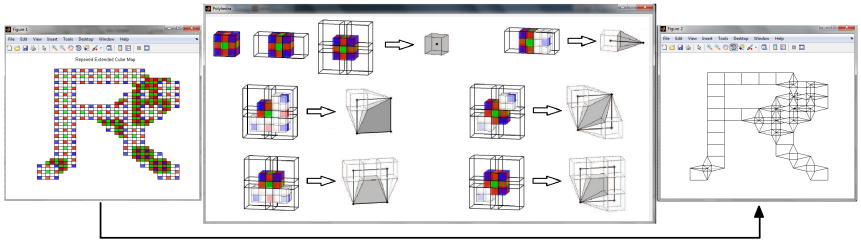

Figure 3: Repaired ECM and polyhedral complex $P(I)$.