**Introduction**

This poster presents a novel automatic PolyCube construction algorithm using centroidal Voronoi tessellation (CVT) based surface segmentation. Given a smooth surface triangle mesh, we segment triangles into six clusters in the surface normal space while satisfying the constraints of PolyCube construction. We develop a new harmonic boundary-enhanced CVT (HBECVT) method by including local neighbourhood information in the energy function. Based on the constructed PolyCube, we then generate quality all-hexahedral (all-hex) meshes. The uniform all-hex mesh and volumetric T-mesh can be obtained through the octree subdivision and mapping. We can also generate adaptive all-hex meshes by extracting the dual mesh from a hybrid octree.

**Algorithm Overview**

Fig. 3 An overview of the algorithm.

**CVT based PolyCube Construction**

**HBECVT based Mesh Segmentation**

Given an input triangle mesh \( T \), we partition it into six segments using CVT based segmentation. For any set of values \( C = \{C_j\} \) and any partition \( U = \{U_i\} \), we define the harmonic boundary-enhanced CVT (HBECVT) energy as:

\[
E_{HBECVT}(C|U) = \frac{1}{2} \sum_j \sum_i \|C_j - U_i \|^2 - \int b_i(f(t)) dt
\]

(1)

**Algorithm of HBECVT**

Given: an input triangle mesh \( T \), the weighting parameter \( \lambda \).

1. For each triangle \( t_i \), assign the triangle to the segment whose centroid is nearest to it.
2. For each cluster, determine the cluster mean by minimizing equation (1).
3. If no transfer occurs, return and exit; otherwise, go to Step 1.

**Results and Discussions**

Figs. 5-7 show results of three models. In each example, we show the HBECVT based segmentation result, corresponding PolyCube mapping result, subdivision results in both parametric domain and physical domain, and adaptive all-hex mesh result. From the results we can observe that sharp features are well preserved and the obtained adaptive meshes all have high quality (minimal Jacobian \( > 0.10 \)).

**Conclusions and Future Work**

**Contributions:** A novel automatic PolyCube construction algorithm using HBECVT based mesh segmentation is developed. Moreover, a new mesh generation algorithm is proposed based on a hybrid octree to construct adaptive all-hex meshes with good quality. Our method can also generate T-meshes with good quality, which can be directly used to construct T-splines.

**Future works:** To construct solid T-spline, which can be used for the isometric analysis.

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