Surface Mesh Normals Filter

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Abstract

We have previously developed a new surface mesh data structure in itk (`itk::QuadEdgeMesh` [1]). In this document we describe a new filter (`itk::QENormalFilter`) to estimate normals for a given triangular surface mesh in this data structure. Here we describe the implementation and use of this filter for calculating normals of a `itk::QuadEdgeMesh`.

Contents

1 Description

This filter takes as input one triangular surface mesh (`itk::QuadEdgeMesh` [1]) and returns one triangular surface mesh with face normals stored in the `CellDataContainer` and vertex normals stored in the `PointDataContainer`. It first computes the normal to all faces, and then calculates the normal for each vertex as the weighted sum of the normals of the neighboring faces [3].

2 Implementation

For a given triangular face on a given triangular surface oriented mesh, the normal is computed as the cross product of oriented vectors in order to make the orientation consistent. Then the vertex normal is computed

as a weighted sum of the normal to the neighboring faces:

$$\mathbf{n_v} = \frac{\sum\limits_{i=0}^{\#f} w_i \cdot \mathbf{n}_i}{\left\| \sum\limits_{k=0}^{\#f} w_k \cdot \mathbf{n}_k \right\|} \tag{1}$$

where $\#f$ is the number of faces around one given vertex $\mathbf{v}$, w_i is a weight parameter which depends on the variable `m_Weight`:

GOURAUD: $w_i = 1$ for any triangle [2],

THURMER: w_i is the angle of the considered triangle at the given vertex [4],

AREA: w_i is the area of the considered triangle.

Note. *One can easily makes his or her own weight, or reimplements other weights (see [3]), by modifying the method* `itk::QENormalFilter::Weight`.

3   Usage

This filter is really easy to use, see given example `NormalFilter.cxx`.

Acknowledgment

References

[1] Alexandre Gouaillard, Leonardo Florez-Valencia, and Eric Boix. itkQuadEdgeMesh: A discrete orientable 2-manifold data structure for image processing. *Insight Journal*, July-December 2006. http://hdl.handle.net/1926/306. (document), 1

[2] Henri Gouraud. Continuous shading of curved surfaces. *IEEE Transaction on Computers*, 20(6):623–629, 1971. 2

[3] Shuangshuang Jin, Robert R. Lewis, and David West. A comparison of algorithms for vertex normal computation. *The Visual Computer*, 21(1-2):71–82, 2005. 1, 2

[4] Grit Thürmer and Charles A. Wüthrich. Computing vertex normals from polygonal facets. *Journal of Graphic Tools*, 3(1):43–46, 1998. 2