Surface Mesh Normals Filter

Arnaud Gelas, Alexandre Gouaillard and Sean Megason

September 7, 2008
Megason Lab, Harvard Medical School

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 1
2 Implementation 1
3 Usage 2

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:

\[ n_v = \frac{\sum_{i=0}^{#f} w_i \cdot n_i}{\left\| \sum_{k=0}^{#f} w_k \cdot n_k \right\|} \]  

(1)

where \( #f \) is the number of faces around one given vertex \( v \), \( w_i \) is a weight parameter which depends on the variable \( m_\text{Weight} \):

**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

This work was funded by a grant from the NHGRI (P50HG004071-02) to found the Center for in toto genomic analysis of vertebrate development.

References


