**Bilateral Mesh Denoising**

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1．本论文的研究意义和研究现状及发展动态分析，附主要参考文献目录）；20分

**Research meaning：**

Removing the noise while preserving the underlying sampled surface, in particular its fine features.What to preserve its feature is a challenge in mesh denoising.

**Research present situation：**

(1)The extensive research on image denoising serves as a foundation for surface denoising and smoothing algorithms.

(2) Mesh denoising methods are based on image denoising approaches.

(3) Image denoising is part of on-going research in image processing and computer vision. The state-of-the-art approaches to image de- 950 noising include: wavelet denoising [Donoho 1995], nonlinear PDE based methods including total-variation [Rudin et al. 1992], and bilateral filtering [Tomasi and Manduchi 1998].

(4) The bilateral filter, introduced by Tomasi and Manduchi [1998], is a nonlinear filter derived from Gaussian blur, with a feature preservation term that decreases the weight of pixels as a function of intensity difference. I.

(5) It successfully removes noise from meshes while preserving features. Furthermore, the presented algorithm excels in its simplicity both in concept and implementation.

**Trend in development analysing：**

Now ，it successes in some ways:

The mesh-denoising algorithm that modifies vertices in the normal direction. The bilateral filtering algorithm that we use is practical, clear and simple. The proposed method deals with irregular meshes and does not perform any reparameterization. In addition, the only property of the mesh that we use isthe topological information, and therefore, the algorithm can be adapted to pointbased representations.

In future,it also has some ways to solve:

(1) Finding a high-order, feature-preserving function for the noise-free surface is a difficult problem.

(2) The key points of our algorithm are the choice of tangent plane and moving vertices along the normal direction. However, this change in vertex position may lead to self-intersection of the denoised mesh

（3）Highly irregular meshes are uncommon in scanned data-sets. To handle irregular data-sets, the parameters must be adjusted locally.

2．**本论文的研究内容、研究目标，以及解决的关键问题**（此部分为重点阐述内容）**；20分**

**Research content**：

（1）This paper focuses on mesh denoising, which is an important preprocess for many digital geometry applications that rely on local differential properties of the surface.

（2）The contribution of this paper is a mesh denoising algorithm that operates on the geometric component of the mesh. The origin of the denoising algorithm is the bilateral filter that has a simple and intuitive formulation, is fast and easy to implement, and adapting it to meshes, yields results that are as successful as its predecessor.

**Research target：**

The extensive research on image denoising serves as a foundation for surface denoising and smoothing algorithms. However, adapting these algorithms from the two dimensional plane to a surface in three dimensions is not straightforward for three main reasons: (i) Irregularity; unlike images, meshes are irregular both in connectivity and sampling, (ii) Shrinkage; image denoising algorithms are typically not energy preserving. While this is less noticeable in images, in meshes, this is manifested as shrinkage of the mesh, (iii) Drifting; naive adaptation of an image denoising technique may cause artifacts known as vertex drifts, in which the regularity of the mesh decreases。

Because Mesh denoising methods are based on image denoising approaches,so above is our goal to research.

**The key problem what had solved：**

Removing the noise while preserving the underlying sampled surface, in particular its fine features.And it has solve three problem:irregularity,shrinkage,drifting.

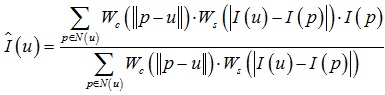
3．**本论文采取的研究方案**；30分

It first introduces the Bilater mesh denoising is use local neighborhood and define a local parameter space for every vertex using the tangent plane to the mesh at a vertex. . The heights of vertices over the tangent plane are synonymous with the gray-level values of an image, and the closeness components of the filter are the tangential components. The term offset is used for the heights.Explaining what is mesh denoising and how it to implementation.

This is how to update v: vˆ = v+d · n

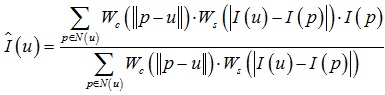
Then it departs five parts to introduce the Bliateral mesh denoising in detail.I will introduce some ways in my view.

(1) Bilateral filtering of images.

Following the formulation of Tomasi and Manduchi [1998], the bilateral filtering for image I(u), at coordinate u = (x, y), is defined as:

中文的分析：

首先定义每个顶点u的计算域，空间域定义为顶点u到计算域内其他顶点p的距离，值域定义为计算域内其他顶点p到顶点u切平面的带符号距离，然后利用双边滤波方法计算顶点u在法向上的移动距离，更新完网格所有顶点位置后即完成一次迭代。具体公式如下：



其中空间域核Wc(x) = e-x2/2σc2，值域核Ws(x) = e-x2/2σs2，N(u)为满足||u - pi|| < ρ = 2σc的顶点集{pi}，I(p)为顶点p到顶点u切平面的带符号距离，最后计算得到的I(u)即为顶点u需要在其法向上移动的距离。

(2) Algorithm.

(3) Mesh shrinkage and vertex-drift.

Our algorithm, also shrinks the object. This can be observed when smoothing a vertex that is a part of a curved patch; the offset of the vertex approaches the average of the offsets in its neighborhood. Therefore, we follow the volume preservation technique.

Our algorithm moves vertices along the normal direction, and so, no vertex-drift occurs.

(4) Handling boundaries.

Our filter inherently handles boundaries by treating them as sharp edges with virtual vertices at infinity. T

(5) Parameters.

The parameters of the algorithm are: σc, σs , the kernel size ρ, and the number of iterations. We propose an intuitive user-assisted method for setting these parameters. Two parameters, σc and σs are interactively assigned: the user selects a point of the mesh where the surface is expected to be smooth, and then a radius of the neighborhood of the point is defined. The radius of the neighborhood is assigned to σc, and we set ρ = 2σc. Then σs is set to the standard deviation of the offsets in the selected neighborhood.

Finally , it has implemented the bilateral mesh denoising algorithm as described in the previous section and compared our results to the results of the anisotropic denoising of height fields algorithm (AFP) [Desbrun et al. 2000], Jones et al. [2003], and the implicit fairing (IF) algorithm [Desbrun et al. 1999] 1 . which to let us realize our algorithm is great in some ways.

4．**本论文的创新之处；10分**

The article’s innovation what I think has three aspects.

Firstly,the article introduce image denoising has some shortcomeing,which provide us a thingking to image our algorithm how to solve it.

Secondly,the article introduce bilateral mesh denoising in detail which use some parts to explain for us.It also is our research scheme.

Finally,it use comparison.it shows us the scanned model,other people’s algorithm’s result and our algorithm’s result.That give us a impressive feeling.

**5. 心得体会；20分**

This paper reading has two parts feeling for me.

Firstly,it is difficult to us,but I like challenge and I like to do it by myself.so this paper reading is rely on myself.which is a preparion for my CET 6 examination.What I to do is to print this paper and look up in a dictionary to solve the word what I incognizance.It spends our about two days to do it.In this paper,the bilateral mesh denoising what I think is hard to me.because it refers to some algorithm.So I read it some times.Final,although I understand it vaguely,but I also study many thing which I can’t speak out.

Secondly,because I read English paper a little,it broaden my horizon and I also study new words.It boost my interest in English reading in a way.So in next life,I propose to spend some my spare time to read English papers.What's more,it is a good habit to write English papers.Although our speak Chinese,it is a compete in our life that us many aspects.

In paper reading,I also surf the internet to help me to solve the problem which I can’t solve or I can’t understand.So I think use tools in our sides which can help our to understdand something more easy,.But something we must rely on ourselves.