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The Power Crust –Pole Removal and Size Reduction

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Abstract*—Surface reconstruction is to find a surface from a given finite set of geometric sample value. Surface reconstructing 3D surfaces from point samples is a well studied problem in computer graphics. All algorithms, aim to solve this problem must overcome several difficulties. One of them is related to the size & quality of the input, under sampling and noise. Power Crust algorithm plays an important role due to its guaranteed quality of triangular mesh generation. Power Crust algorithm monitors the various parameters of mesh generation and evaluates the performance of the algorithm by calculating parameters. The goal of the algorithm is to filter out left insignificant data while preserving an acceptable level of output quality. Hence reduces the size.*

***Keywords*—** *Reverse Engineering, Crust Algorithm, Delaunay Triangulation, Power Crust.*

1. INTRODUCTION

Surface reconstruction is study about finding surface from given finite set of geometric sample values. It allows fitting of scanned data, filling of surface holes, & re-meshing of existing models. Most surface reconstruction methods grouped mainly into two, explicit methods and implicit methods. Reverse engineering of geometric shapes is the process of converting a large number of measured data points into a concise and consistent computer representation. In the way that it is the inverse of the traditional CAD/CAM procedures, which create physical objects from CAD models [7]. Triangulating scattered point-sets is a very general flaw in reverse engineering. Given a set of unorganized points which lie approximately on the boundary surface of a three-dimensional object, and without a prior information about topology, our aim is to reconstruct the surface by constructing a triangular mesh using the given points as vertices [1]

The Delaunay triangulation is a cell complex that subdivides the convex hull of the sampling. If the sampling fulfils certain non-degeneracy conditions then all cells in the Delaunay triangulation are surplices and the Delaunay triangulation is unique [10] Explicit methods are mainly local geometric approaches based on Delaunay triangulation and dual. Voronoi diagram such as Alpha shape and CRUST algorithm. Modern 3D scanners make it possible to acquire several (ten) millions of sample points on the object's surface. Algorithms which reconstruct surfaces from large data have been proposed in the past. The explicit methods are subject to many reconstruction difficulties such as no uniformity, under sampling, and noise [5].

2. LITERATURE REVIEW

Sithu Bala [1] develops a system for image reconstruction from scattered cloud points. Various algorithms like crust algorithm and Delaunay algorithm will be implemented and compared for time taken by the algorithm for surface reconstruction .Keyword surface reconstruction, feature point . Delaunay-based surface reconstruction approaches were mainly developed in the field of computational geometry. This technique functions best when it is possible to control the sampling density over the surface In this paper, presented the feature point technique as in for large cloud points of a image surface reconstruction according to the local feature size, we propose a new fast and effective method that not only give good reconstruction to the smooth areas of the given surface, but also restores the sharp features.

Agostinho de Medeiros [2] describes the multi-resolution approach for surface reconstruction from clouds of unorganized points representing an object surface in 3D space. The given method uses a set of mesh operators and simple rules for scrupulous mesh refinement, with a scheme based on Kohonen's self-organizing map (SOM). Basically, a self-adaptive scheme is used for continual moving vertices of an initial simple mesh in the direction of the set of points near the object boundary. Subsequent refinement and motion of vertices are applied chiefly to a more precise surface, in a multi- resolution, iterative scheme. Reconstruction was experimented with certain point sets, including various shapes and sizes. Results show resulted meshes very close to object actual shapes. We include measures of performance and also discuss robustness.

Andrei C. Jalba [3] present that after accumulating the sample points on a volumetric grid, a novel, iterative algorithm is applied to analyse grid points as exterior or interior to the surface. This algorithm is based on intrinsic properties of the smooth scalar field on the grid which emerges after the aggregation action. Second, a mesh-smoothing paradigm established on a mass-spring system is introduced. By augmenting this system with a bending-energy minimizing term we

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ensure that the final triangulated surface is smoother than piecewise linear in speed and flexibility, the method compares with respect to previous approaches .Most parts of the method are implemented on modern graphics processing units (GPUs). Results in a wide variety of settings are presented, ranging from reconstruction on noise-free point clouds to gray scale image segmentation.

Shengjun Liu [4] present to develop framework for processing point clouds that improves their quality and thus the reconstructed surfaces' quality. The input to our framework is an unorganized point cloud that might contain outliers, noise & non uniformities. On basis the of point positions, our framework uniformly distributes points by inserting samples into sparse regions, using interlaced down sampling and up sampling and many operators. Particularly we use particle repulsion to ensure that the inserted sample points extrapolate the point set's missing points.

Vikas Chauhan [5] present work is to study the Crust algorithm and Delaunay algorithm. We analyse these algorithm for the time taken for the surface reconstruction. The objective of surface reconstruction is to find a surface from a given finite set of geometric sample value the optimization of surface reconstruction system from scattered cloud points. This simulation result are in the form of graphs of time taken to complete surface reconstruction v/s the number of cloud points.

Cheng Tai [6] study novel graph-cuts-based method is suggested for reconstructing open surfaces out of unordered point sets. Using a Boolean operation on the crust around the data set, the open surface problem is changed to a watertight surface problem within a confined region. Integrating the variational model, Delaunay-based tetrahedral mesh & multiphase technique, the suggested method can reconstruct open surfaces robustly and adequately. Furthermore, a surface reconstruction method with domain decomposition is discussed, which is based on the recent open surface reconstruction method.

Shivali Goel [7] develops a system for image reconstruction from scattered cloud points. Crust algorithm along with umbrella Filtering will be implemented and compared for time taken by the algorithm for surface reconstruction. The main aim of the algorithm is to filter out left insignificant data while preserving an acceptable level of output quality. Three-dimensional data collected by measuring device is usually dense and is called Point Cloud data

R. Poranne1 [8] develop a generalized distance function on an un-oriented 3D point set and shows how it may be used to Reconstruct a surface approximating these points. The distance function is shown to be a Mahalano bis distance in a higher-dimensional embedding space of the points, the resulting reconstruction algorithm a natural extension of the attic Radial Basis Function (RBF) approach. Experiment`s results reveals the superiority of our reconstruction algorithm to RBF and other methods in a variety of practical scenarios describe a novel construction of an unsigned distance function from sample data (without normal information). This function gets very small values on the data, which increase smoothly and monotonically with distance from the data. Thus, almost no spurious components will be present in the reconstruction.

Tong-guang [9] applied the BPA to datasets of large no of points showing a real scans of complex objects in 3D. The small amount of memory required by the BPA, time efficiency, and the result's quality are compared favourably with existing techniques

3. NEW PROPOSED SCHEME

Changes are applied to existing power crust to remove redundant points.

The main objectives are:

- To develop a system for image reconstruction from scattered cloud points.
- Power crust algorithm with filtering will be implemented and compared for space taken by the algorithm for surface reconstruction.

4. RESULTS

The proposed work is implemented in C language using the ubuntu platform. The output is produced in geomview software which is used for displaying 3 dimensional objects. In my thesis initially calculate the number of bad poles by using power crust algorithm and after that applying the filtration to produce the smooth surface.

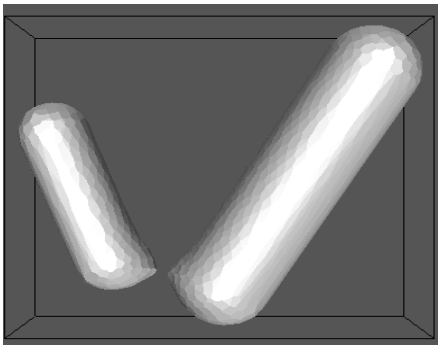

Figure1: Hotdogs

```
neha@neha-laptop:~/powercrust$ ./surface -m 1000000 -i hotdogs.pts
```

Where: Power crust is the file name, surface is the executable file, numeric value (1000000) is a multiplier used For rounding off the coordinates, i is the input file.

```
neha@neha-laptop:~/powercrust$ ./filter -i poleinfo -o neha -r 0.1
```

Where: Filter is the executable file ,-i is the input file name ,-o is the object file ,-r is the redundant data for which Different values are taken to obtain diff results.

```
rw-r--r-- 1 neha neha   99297 2014-06-14 15:36 neha
```

It shows the size of object file after the removal of insignificant poles and also the time at which the file has formed .below graph shows all the values of changed size corresponding to diff values of r.

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Table 1: Computation of Size using Power crust Algorithm of Image Hotdog

R	Removed Poles	Sizes in KB
0.1	1182	99297
0.2	1231	96986
0.3	1246	96283
0.4	1256	95808
0.5	1261	95572

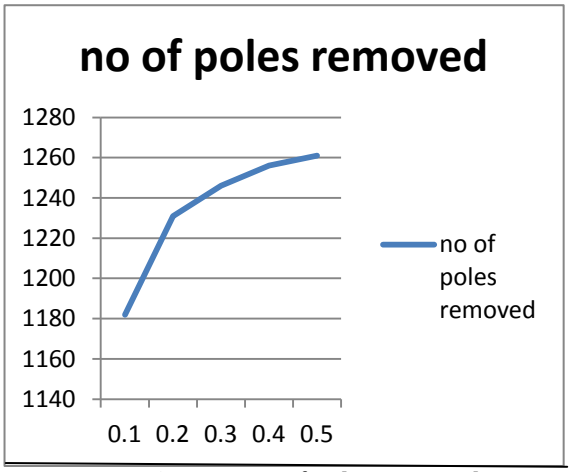

Figure2: No of Poles Removed

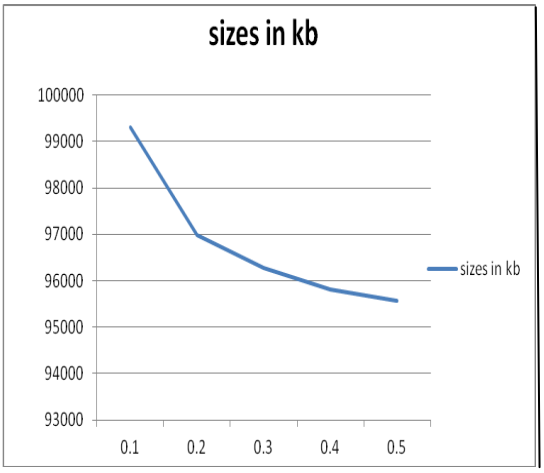

Figure 3: Sizes in KB

5. CONCLUSION

Power crust proposes optimization of mesh reconstruction system from 3D cloud point. Power crust algorithm computes the number of vertices, number of edges and orientation of the image. After filtration the number of insignificant poles can be calculated based on the number of vertices and edges so that surface can be improved. Smooth surface can be obtained when the number of insignificant poles reaches to zero. As the unnecessary poles reduces so as the size. The result are shown in the form of graph which reveals, no of poles removed is directly proportional to the size.

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