

Voronoi diagram, global clustering, and Laplace graphic. Although more accurate resampling can be achieved, these methods require high computational complexity and are generally incapable of providing flexible local resampling solutions.

[0010] The state of art resampling methods include Centroidal Voronoi Tessellation (CVT), Laplace graphic and particle-based resampling. Such methods resample the raw point cloud into an isotropic one with certain point number control in local tangent space. Such resampling methods also support point cloud-based mesh reconstruction. However, such methods smooth the raw point cloud in a local tangent space and some geometric features will be lost. The point positions are changed by such methods which cannot be used in point cloud simplification with strict point position restriction. Furthermore, Laplace graphic and Centroidal Voronoi Tessellation (CVT) cannot satisfy the four requirements for effective and efficient global resampling at the same time.

[0011] Thus, there is a need for methods for point cloud resampling which overcomes the drawbacks of conventional point cloud resampling methods and provide correct local region, uniform density, point number control, and geometric feature keeping. Furthermore, other desirable features and characteristics will become apparent from the subsequent detailed description and the appended claims, taken in conjunction with the accompanying drawings and this background of the disclosure.

SUMMARY

[0012] According to at least one aspect of the present embodiments, a computer-implemented method for voxel-structure-based point cloud resampling to generate a 3D point cloud model of a real-world object is provided. The method includes receiving a point cloud comprising a plurality of points, the point cloud representing the real-world

object, dividing the point cloud into a plurality of voxel boxes based on adjacency of each of the plurality of voxel boxes to its closest neighbours, each of the plurality of voxel boxes defining a local region in a three-dimensional space. The

method also includes point cloud resampling the plurality of points based on an approximate intrinsic voxel structure to generate a resampled point cloud of the real-world object, wherein the point cloud resampling is implemented differently in at least two of the plurality of voxel boxes.

[0013] According to other aspects of the present embodiments, a computer-implemented method for point cloud simplification and a computer-implemented method for voxel-structure-based mesh reconstruction are provided which also include the receiving a point cloud comprising a plurality of points, the point cloud representing the real-world object, dividing the point cloud into a plurality of voxel boxes based on adjacency of each of the plurality of voxel boxes to its closest neighbours, and point cloud resampling the plurality of points based on an approximate intrinsic voxel structure of the computer-implemented method for voxel-structure-based point cloud resampling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The accompanying figures, where like reference numerals refer to identical or functionally similar elements throughout the separate views and which together with the detailed description below are incorporated in and form part of the specification, serve to illustrate various embodiments and to explain various principles and advantages in accordance with present embodiments.

[0015] FIG. 1 depicts an illustration of a pipeline for point cloud processing including AIVS-based point cloud resampling in accordance with the present embodiments.

[0016] FIG. 2 depicts an illustration of a smoothing process for a 2D point cloud with noise in accordance with the present embodiment.

[0017] FIG. 3, comprising FIGs. 3A, 3B and 3C, depicts illustrations of point cloud down-sampling by octree in accordance with the present embodiments, wherein FIG. 3A depicts octree down-sampling, FIG. 3B depicts an original point cloud rendering of

CLAIMS

What is claimed is:

1. A computer-implemented method for voxel-structure-based point cloud resampling to generate a 3D point cloud model of a real-world object, the method comprising:

receiving a point cloud comprising a plurality of points, the point cloud representing the real-world object;

dividing the point cloud into a plurality of voxel boxes based on adjacency of each of the plurality of voxel boxes to its closest neighbours, and wherein each of the plurality of voxel boxes defines a local region in a three-dimensional space; and

point cloud resampling the plurality of points based on an approximate intrinsic voxel structure to generate a resampled point cloud of the real-world object, wherein the point cloud resampling is implemented differently in at least two of the plurality of voxel boxes.
2. The computer-implemented method in accordance with Claim 1, wherein the point cloud resampling implemented differently in at least two of the plurality of voxel boxes comprises implementing isotropic resampling to generate an isotropic point cloud comprising a number of points.
3. The computer-implemented method in accordance with Claim 2, wherein generating the isotropic point cloud comprises specifying a point number, the point number specifying the number of points of the isotropic point cloud.

4. The computer-implemented method in accordance with Claim 3, wherein generating the isotropic point cloud further comprises generating a globally uniform dense isotropic point cloud, wherein generating the globally uniform dense isotropic point cloud comprises defining each of the number of points of the isotropic point cloud to be equidistant in local regions of the three-dimensional space.

5. The computer-implemented method in accordance with any of Claims 2 to 4, wherein the point cloud resampling implemented differently in at least two of the plurality of voxel boxes further comprises implementing anisotropic resampling of ones of the plurality of points in a second one of the at least two of the plurality of voxel boxes, wherein implementing anisotropic resampling comprises maintaining local uniform density in local region of the at least two of the plurality of voxel boxes.

6. The computer-implemented method in accordance with any of the preceding claims, further comprising before point cloud resampling the step of classifying the plurality of points into categories based on a classification strategy, and wherein the point cloud resampling comprises point cloud resampling ones of the plurality of points at one of a plurality of different resampling rates.

7. The computer-implemented method in accordance with Claim 6, wherein classifying the plurality of points comprises classifying the plurality of points into the categories based on a user-specified classification strategy.

8. The computer-implemented method in accordance with either Claim 6 or Claim 7, wherein the plurality of different resampling rates are user defined.

9. The computer-implemented method in accordance with either Claim 6 or Claim 7, wherein the plurality of different resampling rates are determined in response to one of the categories into which the one of the plurality of points being resampled has been classified

10. The computer-implemented method in accordance with any of the preceding claims, further comprising before point cloud resampling the steps of:

pre-processing the point cloud; and

constructing the approximate intrinsic voxel structure of the plurality of points of the point cloud.

11. The computer-implemented method in accordance with Claim 10, wherein pre-processing the point cloud comprises:

denoising the plurality of points of the point cloud to generate a denoised plurality of points;

octree down-sampling of the denoised plurality of points to generate a down-sampled plurality of points; and

up-sampling the down-sampled plurality of points to generate an up-sampled plurality of points of the point cloud with certain point number and uniform density, wherein constructing the approximate intrinsic voxel structure comprises constructing the approximate intrinsic voxel structure of the up-sampled plurality of points of the point cloud.

12. The computer-implemented method in accordance with any of the preceding claims, wherein the point cloud resampling implemented differently in the at least two of the plurality of voxel boxes comprises parallelly processing the point cloud resampling in the at least two of the plurality of voxel boxes.

13. The computer-implemented method in accordance with any of the preceding claims, further comprising deleting redundant points of the resampled point cloud until the plurality of points within the resampled point cloud are equal to a user-specified number of points.

14. A computer-implemented method for point cloud simplification, comprising the method for voxel-structure-based point cloud resampling of any of Claims 1 to 13.

15. A computer-implemented method for voxel-structure-based mesh reconstruction, comprising the method for voxel-structure-based point cloud resampling of any of Claims 1 to 13.

16. The computer-implemented method in accordance with Claim 15, further comprising:

constructing a mesh based on the resampled point cloud by Delaunay triangulation; and

optimizing the mesh.

17. The computer-implemented method in accordance with Claim 16, wherein optimizing the mesh comprises internal edge rebuilding of the mesh and isotropic remeshing while maintaining geometric features of the mesh.