[CLAIMS]

[Claim 1]

A system for processing input point cloud having points, wherein each point includes a set of attributes including two dimensional (2D) and three dimensional (3D) coordinates and other attributes, comprising:

sensors sensing a scene, and in communication with a computer readable memory to produce the input point cloud;

an output interface;

a processor in communication with the computer readable memory, is configured to:

access the input point cloud;

construct a graph representing the input point cloud, based on each point in the input point cloud representing a node in the graph, and identify and connecting two neighboring nodes in the graph to obtain a graph edge;

determine a graph filtering function based on the constructed graph;

filter each point in the input point cloud by selecting a subset of attributes for the points and applying by the graph filtering function on the selected subset of attributes, to determine at least one value for each point in the input point cloud;

produce a probability for each point, based on the at least one value of the point compared to a total of all values of the points in the input point cloud, and a predetermined number of points in an output point cloud;

sample the input point cloud using random evaluation of the probabilities of each point, to obtain a subset of points in the input point cloud, wherein the subset of points is the output point cloud, such that the determination of the subset of points in the input point cloud includes

determining a second subset of points, where additional points are selected and added to the determined subset of points, wherein the second subset of points provides a greater detail of the input point cloud than a detail of the determined subset of points of the input point cloud;

update the probability factor of remaining points with a scale that is proportional to their Euclidean distances to the points in the determined subset of points; and

store the output point cloud in the computer readable memory or output the output point cloud via the output interface in communication with the processor, wherein the output point cloud is used to assist in subsequent processing and assists in management of the input cloud data.

[Claim 2]

The system of claim 1, wherein the subset of attributes for the points are selected based on a user input.

[Claim 3]

The system of claim 1, wherein the producing of the probability for each point for sampling the input point cloud is based on the at least one value of the point compared to a total of all values of the points in the input point cloud, multiplied by the predetermined number of points in the output point cloud.

[Claim 4]

The system of claim 1, wherein the predetermined number of points in the output point cloud is determined by a user input on a surface of a user input interface in communication with the processor, to set a user number of points as the predetermined number of points in the output point cloud.

[Claim 5]

The system of claim 1, wherein the points in the input point cloud are organized or unorganized.

[Claim 6]

The system of claim 1, wherein the other attributes in the set of attributes for each point are from the group consisting of one or a combination of a color, a temperature, a transparency or a reflectivity.

[Claim 7]

The system of claim 1, wherein the graph edges are connected from a graph node to all neighboring graph nodes that are within a radius of τ.

[Claim 8]

The system of claim 1, wherein the graph edges are connected from a graph node to its K nearest neighboring graph nodes.

[Claim 9]

The system of claim 1, wherein the selected subset of attributes includes 3D coordinates of each point, such that the 3D coordinates is used when determining the output point cloud.

[Claim 10]

The system of claim 1, wherein the selected subset of attributes includes color associated with each point, such that the color is used when determining the output point cloud.

[Claim 11]

The system of claim 1, wherein the probabilities of each point is any predefined positive constant for every graph node.

[Claim 12]

The system of claim 1, wherein the probabilities of each point is calculated from the graph filtering function that is represented by a function of one of a graph random walk (transition) matrix, a graph Laplacian matrix or a graph adjacency matrix.

[Claim 13]

The system of claim 1, further comprising:

outputting the output point cloud for the group consisting of one of visualization, object modeling, hierarchical representation or rendering.

[Claim 14]

The system of claim 1, further comprising:

generating feature descriptors for each point in the output point cloud that summarize the input point cloud; and

detecting objects based on the feature descriptors.

[Claim 15]

The system of claim 1, further comprising:

determining a second graph filtering function based on a graph structure modified from the original graph filtering function that has the graph edges to be removed which are linked to the points within the first point subset, and have self-loop graph edges to be added on them;

selecting an information descriptor with elements being equal to the feature descriptor on the points within the first point subset, and other elements being equal to zero;

calculating an updated information descriptor by applying the determined second graph operator on the selected information descriptor with certain times; and

updating the importance score using the updated information descriptor.

[Claim 16]

The system of claim 1, wherein the determination of subset of points in the input point cloud includes:

determining a second subset of points, where additional points are selected and removed from the determined subset of points, such that the second subset of points provides a lesser detail of the input point cloud than a detail of the determined subset of points of the input point cloud; and

coding the input point cloud from the coaster level to the finer level in a scalable way based on the hierarchical set of points.

[Claim 17]

A method for processing input point cloud having points, wherein each point includes a set of attributes including two dimensional (2D) and three dimensional (3D) coordinates and other attributes, comprising:

sensing a scene via sensors, the sensors are in communication with a computer readable memory to produce the input point cloud;

using a processor in communication with the computer readable memory, the

processor is configured for:

accessing the input point cloud;

constructing a graph representing the input point cloud, based on each point in the input point cloud representing a node in the graph, and identify and connecting two neighboring nodes in the graph to obtain a graph edge;

determining a graph filtering function based on the constructed graph;

filtering each point in the input point cloud by selecting a subset of attributes for the points and applying by the graph filtering function on the selected subset of attributes, to determine at least one value for each point in the input point cloud,

producing a probability for each point, based on the at least one value of the point compared to a total of all values of the points in the input point cloud, and a predetermined number of points in an output point cloud;

sampling the input point cloud using random evaluation of the probabilities of each point, to obtain a subset of points in the input point cloud, wherein the subset of points is the output point cloud, such that the determination of the subset of points in the input point cloud includes determining a second subset of points, where additional points are selected and added to the determined subset of points, wherein the second subset of points provides a greater detail of the input point cloud than a detail of the determined subset of points of the input point cloud;

updating the probability factor of remaining points with a scale that is proportional to their Euclidean distances to the points in the determined subset of points; and

storing the output point cloud in the computer readable memory or outputting the output point cloud via the output interface in communication with the processor, wherein the output point cloud is used to assist in subsequent processing and assists in management of the input cloud data.

[Claim 18]

A non-transitory computer readable storage medium embodied thereon a program executable by a computer for performing a method, the method for processing stored input point cloud having points, wherein each point includes a set of attributes including two dimensional (2D) and three dimensional (3D) coordinates and other attributes, the method comprising:

sensing a scene via sensors, the sensors are in communication with the non-transitory computer readable storage medium to produce the input point cloud;

constructing a graph representing the input point cloud, based on each point in the input point cloud representing a node in the graph, and identify and connecting two neighboring nodes in the graph to obtain a graph edge;

determining a graph filtering function based on the constructed graph;

filtering each point in the input point cloud by selecting a subset of attributes for the points and applying by the graph filtering function on the selected subset of attributes, to determine at least one value for each point in the input point cloud,

producing a probability for each point, based on the at least one value of the point compared to a total of all values of the points in the input point cloud, and a predetermined number of points in an output point cloud;

sampling the input point cloud using random evaluation of the

probabilities of each point, to obtain a subset of points in the input point cloud, wherein the subset of points is the output point cloud, such that the determination of the subset of points in the input point cloud includes determining a second subset of points, where additional points are selected and added to the determined subset of points, wherein the second subset of points provides a greater detail of the input point cloud than a detail of the determined subset of points of the input point cloud;

updating the probability factor of remaining points with a scale that is proportional to their Euclidean distances to the points in the determined subset of points; and

storing the output point cloud in the non-transitory computer readable storage medium or outputting the output point cloud via an output interface in communication with the computer, wherein the output point cloud is used to assist in subsequent processing and assists in management of the input cloud data.