CLAIMS

1. A method (400) for generating map data, the method (400) comprising:

receiving a request to generate an updated map associated with a road network;

generating (402) of a plurality of cells of a real space area, each cell representing a two-dimensional sub-space of the real space area the at least one GPS point received from at least one of a plurality of GPS devices, wherein each of the cells comprise at least one global positioning system (GPS) point, and wherein the real space area comprises the road network;

determining (404) a number of GPS points for each cell of the plurality of cells;

determining (406) a simulated road network based on the numbers of GPS points by analyzing the GPS points using a Smoothed Particle Hydrodynamics (SPH) analysis, wherein the cells of the plurality of cells are particles of the SPH analysis and the number of GPS points per cell of the plurality of cells are a scalar of each cell of the plurality of cells in the SPH analysis;

generating at least one visualization image for the distribution of number of GPS points per cell based on the SPH analysis;

updating the simulated road network by classifying each pixel from the generated at least one visualization image to determine whether the pixel is part of a road or not;

providing an input dataset of the road network by labelling all roads where GPS points exist, wherein labels are obtained by querying an open street map (OSM) and retrieving all existing geometries;

generating a binary image in which every pixel has a first label associated to a road or a second label associated to a non-road area by converting the geometries in the image by drawing a plurality of lines on an empty canvas;

comparing (408) the simulated road network determined using the SPH analysis with the road network of the real space area to identify a first set of road segments that exist in the simulated road network that do not exist in the road network of the real space area; and

generating an updated map including the first set of road segments and the road network of the real space area.

2. The method (400) of claim 1, further comprising:

determining a first plurality of cells, wherein the first plurality of cells includes the plurality of cells and at least one further cell, wherein the at least one further cell comprises no GPS point.

3. The method (400) of claim 1 or 2, further comprising:
providing GPS points from a plurality of mobile phone users in the real space area.

4. The method (400) of any one claims 1 to 3,
wherein the cells of the plurality of cells comprise are spaces of a grid, wherein each cell comprises the same size.

5. The method (400) of claim 4,
wherein each cell is a Geohash.

6. The method (400) of any one of claims 1 to 5,
wherein each of the GPS point of a cell has the same weight as the other GPS points of the same cell.

7. The method (400) of any one of claims 1 to 6,
wherein determining (406) the road network comprises a reconstructing of a continuous field from the plurality of cells, wherein the continuous field is interpreted as a drivable area field.

8. The method (400) of claim 7,
wherein a high value of the continuous field in a certain point of the real space area is interpreted as a high probability of having a road in the point.

9. The method (400) of any one of claims 1 to 8,
wherein determining (406) the road network comprises a number of GPS points per cell interpreted as road existence probability density function.

10. The method (400) of any one of claims 1 to 9,
wherein the input to the SPH analysis represents an unprocessed heatmap built from the GPS points of each cell and the output is a normalized heatmap.

11. The method (400) of claim 1, further comprising:

wherein the classifying is using a deep neural network model with the visualization image as an input into a semantic segmentation.

12. The method (400) of claim 1,

wherein the road segments presented in the road network determined by the SPH analysis are considered as roads missing in the map of the real space area.

13. The method (400) of any one of claims 1 to 12, further comprising:

determining whether there are existing roads in a proximity of new road segments determined by SPH analysis.

14. A data processing apparatus configured to carry out the method (400) for generating map data, the method (400) comprising:

receiving a request to generate an updated map associated with a road network;

generating (402) of a plurality of cells of a real space area, each cell representing a two-dimensional sub-space of the real space area the at least one GPS point received from at least one of a plurality of GPS devices, wherein each of the cells comprise at least one global positioning system (GPS) point, and wherein the real space area comprises the road network;

determining (404) a number of GPS points for each cell of the plurality of cells;

determining (406) a simulated road network based on the numbers of GPS points by analyzing the GPS points using a Smoothed Particle Hydrodynamics (SPH) analysis, wherein the cells of the plurality of cells are particles of the SPH analysis and the number of GPS points per cell of the plurality of cells are a scalar of each cell of the plurality of cells in the SPH analysis;

generating at least one visualization image for the distribution of number of GPS points per cell based on the SPH analysis;

updating the simulated road network by classifying each pixel from the generated at least one visualization image to determine whether the pixel is part of a road or not;

providing an input dataset of the road network by labelling all roads where GPS points exist, wherein labels are obtained by querying an open street map (OSM) and retrieving all existing geometries;

generating a binary image in which every pixel has a first label associated to a road or a second label associated to a non-road area by converting the geometries in the image by drawing a plurality of lines on an empty canvas;

comparing (408) the simulated road network determined using the SPH analysis with the road network of the real space area to identify a first set of road segments that exist in the simulated road network that do not exist in the road network of the real space area; and

generating an updated map including the first set of road segments and the road network of the real space area.

15. A non-transitory computer-readable medium storing computer executable code comprising instructions for generating map data according to the method (400) for generating map data, the method (400) comprising:

receiving a request to generate an updated map associated with a road network;

generating (402) of a plurality of cells of a real space area, each cell representing a two-dimensional sub-space of the real space area the at least one GPS point received from at least one of a plurality of GPS devices, wherein each of the cells comprise at least one global positioning system (GPS) point, and wherein the real space area comprises the road network;

determining (404) a number of GPS points for each cell of the plurality of cells;

determining (406) a simulated road network based on the numbers of GPS points by analyzing the GPS points using a Smoothed Particle Hydrodynamics (SPH) analysis, wherein the cells of the plurality of cells are particles of the SPH analysis and the number of GPS points per cell of the plurality of cells are a scalar of each cell of the plurality of cells in the SPH analysis;

generating at least one visualization image for the distribution of number of GPS points per cell based on the SPH analysis;

updating the simulated road network by classifying each pixel from the generated at least one visualization image to determine whether the pixel is part of a road or not;

providing an input dataset of the road network by labelling all roads where GPS points exist, wherein labels are obtained by querying an open street map (OSM) and retrieving all existing geometries;

generating a binary image in which every pixel has a first label associated to a road or a second label associated to a non-road area by converting the geometries in the image by drawing a plurality of lines on an empty canvas;

comparing (408) the simulated road network determined using the SPH analysis with the road network of the real space area to identify a first set of road segments that exist in the simulated road network that do not exist in the road network of the real space area; and

generating an updated map including the first set of road segments and the road network of the real space area.