CLAIMS

1. A computer-implemented training method (100) of training a map segmenter (10) comprising a deep neural network, comprising:

providing (110) a training dataset (TDS1) comprising training image data comprising training pairs (TDP1) of map images (22) of a geographical area (GA1) acquired by one or more image acquisition apparatuses (SAT1) and corresponding segmentation masks (32), wherein the training image data is stored in a computer memory (CM1);

generating synthetic map images (42) by a computer-implemented generation method (200) comprising creating (210) synthetic map images (42) by applying a generative adversarial network (GAN) onto segmentation masks (30), wherein the segmentation masks (30) comprise the corresponding segmentation masks (32) and additional segmentation masks (34);

storing (130) the synthetic map images (42) and the corresponding additional segmentation masks (34) as additional training data pairs (TDP2) in the training dataset (TDS1) in the computer memory (CM1); and

training (140) the map segmenter (10) with the training dataset (TDS1),

wherein the training dataset (TDS1) comprises one or more batches, each batch thereof comprising a segmentation mask and a plurality of synthetic map images generated from the segmentation mask; and wherein the training method (100) further comprises calculating a batch quality score (BQS) for each batch.

2. The training method (100) of claim 1, wherein the additional segmentation masks (34) are provided by:

a segmentation mask database and wherein the additional segmentation masks (34) are different from the corresponding segmentation masks (32) corresponding to the map images (22); or

a segmentation mask generator configured to generate a representation of a road network and transform the representation into the additional segmentation masks (34).

3. The training method (100) of claim 1 or claim 2, wherein the generative adversarial network (GAN) is trained by training:

a generator model (G1) with a segmentation mask of the segmentation masks (30); and

a discriminator model (D1) configured to discriminate between an image generated by the generator model (G1) and a map image corresponding to the segmentation mask.

4. The training method (100) of any one of claims 1 to 3, wherein creating (210) synthetic map images (42) comprises augmenting the map images (22) by applying the generative adversarial network (GAN) on the corresponding segmentation masks (32) thereby producing augmented images (42); and the training method (100) comprises storing the augmented images (42) with their corresponding segmentation masks (32) in the training dataset (TDS1) in the computer memory.

5. The training method (100) of any one of the previous claims, wherein creating (210) synthetic map images (42) comprises:

creating a synthetic image of the synthetic map images (42) by applying the generative adversarial network (GAN) onto an additional segmentation mask comprised by the additional segmentation masks (34).

6. The training method (100) of any one of the previous claims, wherein the generative adversarial network (GAN) comprises a conditional-single natural image generative adversarial network (cSinGAN) or a derivate thereof.

7. The training method (100) of any one of the previous claims, wherein the generative adversarial network (GAN) comprises a Multi-Categorical-conditional-single natural image generative adversarial network (Multi-Categorical-cSinGAN) or a derivate thereof.

8. The training method (100) of claim 6, wherein

the conditional-single natural image generative adversarial network (cSinGAN) comprises two or more generators (CAT=1, CAT=2), each trained for a category of categories; and

the training method (100), further comprises, for each generator (CAT=1, CAT=2):

inputting a noise tensor into the conditional-single natural image generative adversarial network (cSinGAN).

9. The training method (100) of claim 7, wherein

the Multi-Categorical-conditional-single natural image generative adversarial network (Multi-Categorical-cSinGAN) comprises a multi-scale generator set,

and the training method (100) further comprises

selecting a noise section (54) from a region (52) of a noise space (50), the region (52) corresponding to a given category of categories, wherein the noise section (54) is randomly selected within the region (52); and

inputting the noise section (54) as noise tensor into the multi-scale generator set.

10. The training method (100) of any one of previous claims, further comprising comparing batch quality scores of different batches and:

selecting a batch having a highest batch quality score (BQS) among one or more batches; or

calculating a batch similarity (BS), and calculating a batch selection score (BSS) based on the batch similarity (BS) and the batch quality score (BQS), and selecting batches according to the batch similarity (BS);

wherein the batch quality score (BQS) is calculated based on an appearance distance and a content information distance, and

wherein the batch similarity (BS) is calculated based on a pairwise structural similarity of two images generated with a same segmentation mask.

11. The training method (100) of claim 10, wherein the structural similarity is Multi-Scale Structural Similarity (MS-SSIM).

12. The training method (100) of any one of the previous claims, wherein training (140) the map segmenter (10) with the training dataset (TDS1) comprises at least two training phases, wherein:

at least one of the training phases is performed with the training image data comprising the training pairs (TDP1) and without of additional training data pairs (TDP2); and

at least another one of the training phases is performed with the additional training data pairs (TDP2).

13. A computer-implemented segmenting method (300) for extracting a road network for use in vehicle routing, the segmenting method (300) comprising:

providing a trained segmenter (310) trained by using the training dataset (TDS1) of the training method (100) of any one of claims 1 to 12;

providing processing image data (320) comprising map images acquired by one or more image acquisition devices;

segmenting (330), by the trained segmenter (310), each of the map images thereby determining attributes to different portions of the map images; and

storing (340) the segmented images and/or the attributes as the road network in a database memory for access by vehicle routing services.

14. The method (300) of claim 13, wherein segmenting (330) comprises, by the trained segmenter classifying pixels of a, or each, image of the map images into road and no-road.

15. The method (300) of claim 13 or claim 14, further comprising, by a computing system (60):

receiving (345), by a communication interface, a route request from a user’s mobile device (70);

applying (350) a route solver on the route request, on a road map produced from the road network, and a fleet of vehicles, thereby providing a viable route for a vehicle (80) of the fleet;

sending (355) route data of the viable route to the vehicle (80);

receiving (360) an acknowledgement of service from the vehicle (80);

sending (365) the route data, by the communication interface, to the user’s mobile device (70); and

sending (370) the acknowledgement of service, by the communication interface, to the user’s mobile device (70).

16. The method (300) of claim 13 or claim 14, further comprising, by a computing system (60):

receiving (345), by a communication interface, a route request from a vehicle (80);

applying (350) a route solver on the route request and a road map produced from the road network, thereby providing a viable route for the vehicle (80); and

sending (355) route data of the viable route to the vehicle (80).

17. A computer program product comprising program instructions, which when executed by one or more processors, cause the one or more processors to perform the training method (100) of any one of claims 1 to 12 or the segmenting method (300) of any one of the claims 13 to 16.