CLAIMS

What is claimed is:

1. A method for map matching that finds a true road that a moving object is on, the method comprising:

receiving trajectory information of the moving object that includes road arcs that can be an actual path of the moving object; and

finding the true road that the moving object is on by:

modelling each road arc as a hidden state and each location measurement as an observation emitted by the hidden state using a Hidden Markov Model;

decoding each road arc and each location measurement using a Viterbi algorithm; and

outputting a matching road arc that represents the true road that the moving object is on,

wherein the outputting is delayed by a delay time that is adaptively determined in response to an optimal tradeoff between selection accuracy and selection latency.

2. The method in accordance with claim 1 wherein the modelling step comprises:

narrowing a set of candidate road arcs to generate a reduced set of candidate road arcs;

modelling each road arc in the reduced set of candidate road arcs as the hidden state and each location measurement as the observation emitted by the hidden state using the Hidden Markov Model; and

decoding each road arc in the reduced set of candidate road arcs and each location measurement using a Viterbi algorithm.

3. The method in accordance with claim 1, wherein the delay time is selected by minimizing a function of the selection accuracy and the selection latency, the selection accuracy being a decreasing function of the delay time and the selection latency being an increasing function of the delay time.

4. The method in accordance with claim 3, wherein the selection accuracy is determined by an information entropy of a probability distribution which indicates a likelihood of each road arc being the matching road arc.

5. The method in accordance with claim 3, wherein the selection latency is determined by a function of a tradeoff parameter and the delay time.

6. The method in accordance with claim 1, wherein the optimal tradeoff is modelled as a ski-rental problem model, and wherein the optimal tradeoff between the selection accuracy and the selection latency adaptively determines whether to continue decoding while incurring additional selection latency or outputting a matching road arc while incurring additional selection accuracy in response to the ski-rental problem model.

7. The method in accordance with claim 3, wherein the delay time is determined when the selection accuracy is equal to or less than the selection latency.

8. A device for map matching that finds a true road that a moving object is on, the device comprising:

a location data receiving device that receives trajectory information of the moving object;

a memory having road arcs in a road network stored therein;

a user interface including a user presentation device; and

a processor coupled to the location data receiving device, the memory, and the user interface, the processor being configured to:

model each of the road arcs stored in the memory as a hidden state and each location measurement detected by the location data receiving device as an observation emitted by the hidden state using a Hidden Markov Model;

decode each of the road arcs and each location measurement using a Viterbi algorithm; and

output, to the user presentation device, a matching road arc that represents the true road that the moving object is on,

wherein the output is delayed by a delay time that is adaptively determined in response to an optimal tradeoff between selection accuracy and selection latency.

9. The device in accordance with claim 8, wherein the processor is configured to select the delay time by minimizing a function of the selection accuracy and the selection latency, the selection accuracy being a decreasing function of the delay time and the selection latency being an increasing function of the delay time.

10. The device in accordance with claim 9, wherein the processor is configured to determine the selection accuracy in response to an information entropy of a probability distribution which indicates the likelihood of each road arc being the matching road arc.

11. The device in accordance with claim 9, wherein the processor is configured to determine the selection latency by a function of a tradeoff parameter and the delay time.

12. The device in accordance with claim 11, wherein the optimal tradeoff is modelled as a ski-rental problem model, and wherein the optimal tradeoff between the selection accuracy and the selection latency adaptively determines whether to continue decoding while incurring additional selection latency or outputting a matching road arc while incurring additional selection accuracy in response to the ski-rental problem model.

13. The device in accordance with claim 9, wherein the processor is configured to determine the delay time when the selection accuracy is equal to or less than the selection latency.

14. The device in accordance with claim 8 wherein the processor is configured to model each of the road arcs and each location measurement by narrowing a set of candidate road arcs to generate a reduced set of candidate road arcs and modelling each road arc in the reduced set candidate road arcs as the hidden state and each location measurement as the observation emitted by the hidden state using the Hidden Markov Model.