Parallelised Gaussian Mixture Filtering for Vehicular Traffic Flow Estimation

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Large traffic network systems require handling huge amounts of data, often distributed over a large geographical region in space and time. Additionally, the vehicular traffic dynamics exhibits multiple regimes and this complex and nonlinear behaviour requires methods able to represent well multimodal probability density functions. Centralised processing is not then the right choice in such cases. In this paper we develop a parallelised Gaussian Mixture Model filter (GMMF) for traffic networks aimed to: 1) work with high amounts of data and heterogenous data (from different sensor modalities), 2) provide robustness in the presence of sparse and missing sensor data, 3) able to incorporate different models in different traffic segments and represent various traffic regimes, 4) able to cope with multimodalities (e.g., due to multimodal measurement likelihood or multimodal state probability density functions). The efficiency of the parallelised GMMF is investigated over traffic flows based on macroscopic modelling and compared with a centralised GMMF.

The proposed GMM approach is general, it is applicable to systems where the overall state vector can be partitioned into state components (subsets), corresponding to certain geographical regions, such that most of the interactions take place within the subsets. The performance of the paralellised and centralised GMMFs is investigated and evaluated in terms of accuracy and complexity.