Post-Doc Research Proposal

Robust Traffic Prediction for Fluid Traffic Models

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Start: Any time in 2012 Duration: 12 M, Salary: 2620 E Brut



Context: NeCS is a joint CNRS (GIPSA-lab)-INRIA team. The team is bi-located at INRIA (Montbonnot) and at the GIPSA-lab (at the Grenoble campus).This work will be achieved in the framework of HYCON 2 (Highly-Complex and Networked Control Systems) an european network of excellence (http://www.hycon2.eu/) whose applications domain include Transportation systems, and the national project MOCOPO (http://mocopo.ifsttar.fr/) for travelling time bounds prediction. The work will be validated using real-time traffic data from our data collection center, named "Grenoble Traffic Lab" (GTL http://necs.inrialpes.fr/pages/reseach/gtl.php), typically used in our team for model validation and performance assessment of new estimation algorithms for traffic prediction and control.

Topic description: One crucial component in traffic management and information systems is the prediction of traffic states [1]. Unlike several approaches in the literature devoted to transportation systems, we consider a model-based approach by resorting to fluid traffic models that can be described by partial differential equations (PDE) of hyperbolic type. There exist a large variety of these models in the literature, but most of our works relay on the use of the Cell Transmission Model (CTM) which is a switched model and is built from the fundamental diagram characteristics. CTM has been used as a basis to design density observers which allow reconstructing the initial conditions in cells not equipped with sensors, and are the first step for traveling time and density time-ahead prediction [2], [3]. The efficiency of such observers is strongly related to the accuracy of the parameters derived from the fundamental characteristic curve.

The proposed work concern the issues of short-time prediction of both densities and travelling time under uncertainties of different types: unknown but possibly bounded future demand, splitting coefficients, and fundamental diagrams mismatches. The main goal of this work is to derive new prediction and estimation methods sufficiently robust to these uncertainties. Moreover, we aim to provide confidence intervals for predictions on travelling time and density evolutions. To carry out this study, we will first use the data from an already calibrated micro simulator of the Grenoble south ring, and then we will make use of data supplied by the Grenoble Traffic Lab (GTL) from measurements obtained by means of a new sensor network under deployment.

Candidate profile: Strong skills in Systems (control) theory are required (Estimation theory, Model-based Observers design, Robust control & observation).

Related bibliography:

[1] Chrobok, R., Kaumann, O., Wahle, J., and Schreckenberg, M., "Different methods of traffic forecast based on realdata", European Journal of operational Research 155 (2004) 558-568.
[2] Morarescu, I-C., and C. Canudas de Wit, "Highway Traffic model-based density estimation", 2011 American Control Conference - ACC 2011, Jun 2011, San Francisco, CaL. USA.
[3] Canudas de Wit, C., Leon Ojeda, L.R., and Kibangou, A.Y. "Graph constrained-CTM observer design for the Grenoble south ring", 13th IFAC sysmposium on Control in Transportation systems, CTS 2012 (Submitted).