Bayesian models for forecasting in the supply chain

Fully funded PhD position with a fast-growing company

Institution: IMT Lille Douai & CRIStAL Laboratory UMR CNRS 9189
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Subject

The global economy relies heavily on the consumption of goods of all kinds: food, textiles, electronics, equipment, vehicles, etc. The supply chain is the mechanism that accounts for the physical flows of these consumed goods. The supply chain consists of logistics (warehouses, transport vehicles, packaging), finance (billing and payment), and IT (stock status, manufacturing, ordering and shipping). Its efficient functioning has a direct impact on the performance of the economy, on the environment (transport, storage, destruction of useless stock) and on the working conditions of the employees. In this thesis, the objective is to predict the evolution of the outputs in the supply chain, i.e. quantities in locations of storage or sales. The research work of this thesis can be divided into two parts: (1) mathematical modeling of the supply chain, and (2) inference methods for prediction. First, we will model the problem in a probabilistic and generic way, taking into account all possible interactions between the variables of interest. We will develop novel spatio-temporal hierarchical models [1, 2]. In the second part of this thesis, we will develop Bayesian methods for the probabilistic prediction at all stages in the chain [3]. We will propose novel efficient and accurate algorithms, including but not only sequential learning, in order to avoid the need to reprocess all past data every time new data is available [4, 5].

Candidate profile

We are looking for a motivated and talented student with:

– background in machine learning, signal processing, statistics or applied mathematics
– strong mathematical skills
– experience in programming, preferably in Matlab and/or Python.

Details

A **fully funded PhD position with a fast-growing company is available** (three-year contract) from September/October 2018 at IMT Lille Douai and in the SIGMA Team [link], of the CNRS laboratory CRIStAL. Both institutions are located in the scientific campus of Villeneuve d'ascq (Lille).

During the thesis, the student will have the opportunity to collaborate with internationally renowned researchers from institutions such as Stony Brook University-New York (USA), Universidad Carlos III-Madrid (Spain), Institute of Statistical Mathematics-Tokyo (Japan), etc.

The student will enjoy an international and creative environment where research seminars and reading groups take place very often. Moreover, with 36% of the population aged under 25, Lille is a vibrant, young and dynamic city. Lille lies in the heart of the triangle that links three of Europe's main metropoles: London (80 min), Paris (60 min), and Brussels (35 min).

The student will be supervised:

– Víctor Elvira [link]: victor.elvira@imt-lille-douai.fr
– François Septier [link]: francois.septier@imt-lille-douai.fr

The candidate is requested to send us a CV and a motivation letter to apply for this position.

References

[1] N. Cressie, S. Burden, W. Davis, and P. N. Krivitsky, "Capturing multivariate spatial dependence: Model, estimate and then predict," *Statistical Science*, vol. 30, no. 2, pp. 147–163, 2015.
[2] P. Zhang, I. Nevat, G. W. Peters, F. Septier, and M. A. Osborne, "Spatial field reconstruction and sensor selection in heterogeneous sensor networks with stochastic energy harvesting," *IEEE Transactions on Signal Processing*, 2018.
[3] C. P. Robert and G. Casella, *Monte Carlo statistical methods*. Springer, 2004.
[4] F. Septier and G. W. Peters, "Langevin and Hamiltonian Based Sequential MCMC for Efficient Bayesian Filtering in High-Dimensional Spaces," *IEEE Journal of Selected Topics in Signal Processing*, vol. 10, no. 2, pp. 312–327, Mar. 2016.
[5] L. Martino, J. Read, V. Elvira, and F. Louzada, "Cooperative parallel particle filters for online model selection and applications to urban mobility," *Digital Signal Processing*, vol. 60, pp. 172 – 185, 2017.