Reliability theory and industrial applications

Reliability theory, stochastic degradation and surveillance models are a core activity for the team. This activity, conducive to industrial partnerships, is rapidly expanding. A wide range of models are being studied such as Markov renewal processes (e.g. piecewise deterministic Markov processes) or uni- and bivariate degradation models (e.g. Gamma or Brownian motion processes). Research focuses on the probabilistic and statistical study of these models, possibly in the presence of missing or incomplete data, and on the quantification of the corresponding reliability indicators and associated preventive maintenance policies.

In the same vein, experimental design is another focus of interest for the team. Studies concentrate on conventional designs of experiments (small design, block design and consideration of neighboring effects) and also the extrapolation of these techniques to help schedule the use of large-scale numerical computations. As part of a related industrial theme, the team also focuses on the properties of certain quality indices and on developing statistical change point detection methods for managing industrial processes.

Mixture models are another key subject. Under semi- or non-parametric assumptions, the team is particularly interested in identifiability problems, taking into account explanatory variables (regression mixtures) and in algorithmic techniques for estimating parameters such as generalized EM algorithms. Methods for estimating non-parametric models are based on various techniques such as kernel-based regularization.
Again in the field of stochastic modeling and its applications, the team also focuses on actuarial and financial mathematics, and on the optimization and approximation of queuing systems. From an application point of view, optimal management of queuing systems is fundamental in telecommunications and call centers for example. The development of asymptotic approximations such as the fluid approximation approach will help overcome some of the difficulties encountered. The team is investigating certain refinement approaches based on diffusion approximations and large deviations.