

Master thesis proposal - 2016-2017

Heterogeneity in imperfect maintenance modelling.

Mention : Research. This work is intended to be continued as a PhD thesis.

Student profile : Master student in applied probability, statistics, data science. Programming skills in R.

Keywords : Reliability, stochastic processes, mathematical statistics.

Working place : Laboratoire Jean Kuntzmann (LJK), FIGAL team, Université Grenoble Alpes, Grenoble, France.

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Remuneration : Standard internship grant : 550 euros/month, funded by the labex Per-syval, project AMORE (<http://amore2016.imag.fr/>).

Subject of the thesis : Many stochastic models have been proposed to model the ageing of complex industrial systems and the efficiency of their maintenance, in order to assess their reliability, predict their residual life and optimize their maintenance. But these models are not adapted when there exists heterogeneity in the analyzed data. Heterogeneity can be both observed (for instance, when the systems are used under different climate conditions) and not observed (for instance when they suffer from internal dysfunctions).

Recently, Slimacek and Lindqvist [3] have proposed to analyze wind turbine reliability data with models where the observed and not observed heterogeneities are respectively characterized by covariates and frailties. They assume that the system maintenances are perfect, i.e. that each maintenance restores the system into a new one. Of course, this is not the case in practice and the FIGAL team in LJK has proposed several ways of modelling imperfect maintenance [1].

So the aim of the internship is to study imperfect maintenance models with heterogeneity. The resulting model mixes virtual age models (for the imperfect maintenance effect), Cox type proportional hazard models (for the observed heterogeneity) and Bayesian frailty models (for the unobserved heterogeneity). The theoretical properties of the model will be studied. The statistical inference in this model can be parametric or semi-parametric, and could use the method proposed in [2]. The model will be implemented in the R package VAM, developed in LJK. Finally, an application to a real data set is expected.

References

1. BEUTNER E., BORDES L. DOYEN L., The failure of the profile likelihood method for semi-parametric effective age models, *Bernoulli*, to appear, 2016.
2. LI L., HANSON T.E., A Bayesian semiparametric regression model for reliability data using effective age, *Computational Statistics and Data Analysis*, 73, 177-188, 2014.
3. SLIMACEK V., LINDQVIST B.H., Nonhomogeneous Poisson process with nonparametric frailty, *Reliability Engineering and System Safety*, 149, 14-23, 2016.