PhD Proposal in Statistics and Applied Probability
Université de Pau et des Pays de l’Adour

**Title:** On the modelling and statistical analysis of imperfect repairs for a gamma deteriorating system

**Keywords:** Reliability, Gamma process, Estimation procedure, Virtual age model

**Laboratory:** Laboratoire de Mathématiques et de leurs Applications -- Pau (UMR CNRS 5142), Equipe Probabilités & Statistique, [http://lma-umr5142.univ-pau.fr/live/](http://lma-umr5142.univ-pau.fr/live/)

**Contacts:**
- Laurent BORDES ([http://web.univ-pau.fr/~lbordes/](http://web.univ-pau.fr/~lbordes/), Laurent.Bordes@univ-pau.fr, +33 (0)5 59 40 75 38)
- Sophie MERCIER ([http://web.univ-pau.fr/~smercie1/](http://web.univ-pau.fr/~smercie1/), Sophie.Mercier@univ-pau.fr, +33 (0)5 59 40 75 37)

**Subject:**
Reliability theory deals with the probabilistic and statistical study of industrial systems, which are expected to complete their function during a given interval of time. The core of the PhD proposal is about a system which is accumulating deterioration with time. The deterioration level is classically modelled by a Gamma process [Van Noortwijk 2009]. A lot of papers from the literature deal with the study of preventive maintenance policies for this kind of processes. However, most of them consider the repairs (or maintenance actions) as perfect, which is not always the case in an industrial context. The subject of this PhD proposal is on the modelling and on the study of the impact of imperfect repairs on gamma deteriorating systems, from both probabilistic and statistical viewpoints. Extending virtual age models for lifetime recurrent events which have been developed in [Doyen- Gaudoin 2004], the idea is to consider that an imperfect repair removes some part of the deterioration accumulated by the system or that the system is partially rejuvenated by the repair. The efficiency of the repair is then measured by a Euclidian parameter, which corresponds to the proportion of deterioration (or age) removed by the maintenance action. In this context, different models will be considered, according to whether a repair removes some part of all the deterioration/age accumulated since the system was first set up or only since its last repair (or models in between). Also, the analysis will depend on the maintenance scheme, which can be periodic, random but independent of the system intrinsic deterioration (e.g. repairs are performed at the points of an independent Poisson process), or random with dependence, where a repair can be induced by the reaching of some given threshold by the system deterioration level for instance (see e.g. [Mercier – Castro 2013]).

Possible objectives are:
- Study of the distribution of the observed degradation process, including distributions of thresholds hitting times,
- Computation of standard reliability indicators, both theoretically and numerically,
- Optimization of some maintenance scheme,
- Nonparametric or parametric identification problems according to the assumptions on the repair times and on the available data,
- Development of some inference methods (moment or maximum likelihood methods) and study of their numerical behavior,
- Study of the theoretical properties of the resulting estimators (consistency, weak convergence).

*The PhD candidate should have solid backgrounds in statistics and applied probability (Master Degree or an equivalent diploma). Fluent English OR fluent French is mandatory. Some competence in programming (such as R software, Scilab or Matlab) will be appreciated.*

