

Post-doctorate profile

Short description:

The LARIS (Angevin research laboratory in engineering systems - EA 7315) offers a postdoctoral contract for a period of 12 months within the context of a French ANR program on the theme of the prediction, by **probabilistic approaches**, of the durability of civil engineering structural elements repaired or re-classified by means of composite materials.

General context of the MICRO research program

With the necessity of maintenance and upgrading of French civil engineering heritage, the strengthening of deteriorated structures by bonding of composites (fabric laminates on site or rigid strips glued) is a candidate option for extending the life duration of structures.

MICRO research project intends to remove the last difficulties that limit development at a large scale of this repairing process.

Particularly MICRO aims to:

- Understand durability and reliability of the repaired structures through a multi-scale analysis of aging mechanisms and a probabilistic approach. Indeed, the relative lack of knowledge about reliability and complex factors governing durability of these repairs is the main lock considered by practitioners.
- Develop innovative strengthening systems reducing environmental footprint and devoid of carcinogenic, mutagenic and or toxic to reproduction compounds.

The post-doc topic:

In this context, it is mainly to the first objective that the LARIS brings his scientific contribution in building and exploiting the results of **accelerated life tests** carried out at several scales. The probabilized aging/degradation models and the statistical laws of lifetime duration of structures repaired by composite materials will be used for their **reliability-based design**.

With regard to the **accelerated life tests** aspects, at least two objectives are to deal with. The first one is to exploit the results of accelerated aging tests¹ carried out at different levels of temperature and humidity to extract a lifetime distribution law under nominal environmental conditions (temperature, humidity and mechanical stress) then under stochastic conditions. With the reduced number of tests, the coupling of the standard models of accelerated life, models of degradation and Bayesian approaches is necessitated. Still on these aspects, the accelerated life tests, the second objective is to exploit deeply the results of the experimental campaign to propose a method of test plan optimization. It comes here to define the numbers of stress levels, of tests to carry out at each level, of test pieces for the same test, testing times, etc. We will look also at this same stage of optimization how to define the best testing strategy to conduct in the context of qualification of strengthening composite materials. A meta-model of accelerated test, to consider simultaneously the options of tests at constant, progressive, or sequential stresses, will be developed as a basis for this optimization problem.

With regard to the aspects of **reliability-based design**, the objective will be to confront two ways of design. The first way, based on a maintained level of performance, will be to integrate statistical aging models characterized during the first step within the design equations proposed in the existing recommendations. It is basically the probabilization of an existing model. The calibration of safety coefficients will be one of the expected results. The second way, based on the achievement of a lifetime, will directly use the statistical distribution of these lifetimes obtained from aging tests.

Profile of the candidate:

The candidate should have defended a PhD thesis preferentially on the topic of **statistical analysis of degradation or accelerated aging tests** regardless of the application domain. The candidate must have strong skills in applied mathematics. Knowledge in the field of **optimization** and **Bayesian analysis** are also highly appreciated. Completing his doctoral thesis in the field of civil engineering structures is a plus, not a paramount.

Contract: 12 month fixed term contract. Annual gross salary : 34 000 euros (net salary of about 26 100 euros)

Start: 1st March or 1st April 2018

Information:

Interested candidates should send a detailed curriculum vitae, a statement of research interests, and cover and reference letters to M. David BIGAUD (PR) to the address david.bigaud@univ-angers.fr