Reliability modelling of a traction chain in a railway system

INP Toulouse ENIT + Alstom

NICOLAS BAUDIN
INTERNSHIPS IN FRANCE INITIATIVE

Name of the hosting institution in France	INP Toulouse ENIT
Name of the host laboratory / research team	Production Engineering Laboratory
Address	47, avenue d'Azereix 65016 Tarbes Cedex
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Name of the supervisor	Carmen Martin
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Internship offer

Topic of the internship (title)	Reliability modelling of a traction chain in a railway system			
Proposed dates of the internship	**Start:**	2019-09-02	**End**	2020-01-31

Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):

The work envisaged can be integrated within the framework of a "V" analysis linking in a one-to-one way a system level (associable with an electrical energy converter) and a component level (similar to an IGBT) for the implementation of a Safe Operation approach and, more specifically, a reliability assessment methodology. In this respect, the work will concern the characterization of the failure modes of a machine or subsystem and their evolution according to the use profile by modelling the mechanisms characterizing, in a top-down logic, the influence of the solicitation of the system under consideration on the solicitation/deterioration of a component and, by bottom-up analysis, the dysfunctional impact of this failure of the elementary level on the decrease in performance of this system. For the deployment of this approach, several autonomous but connected research paths will have to be followed. They will constitute working bricks that can be assembled later on.

1. At the system level. To obtain reliability, it is necessary to characterize the severity of the environment with which the system under study will be confronted. This requires a qualitative and quantitative description of the influential factors through the definition of a life profile (or mission profile or job profile).
2. In the downward direction: system component. The mission profile of the system is not the same as that of all the elements that make it up. For functional, architectural or localization reasons, the system's load is therefore not identical to that of its components. Assessing the reliability of a component therefore requires translating the system's mission profile into constraints for lower levels in the nomenclature. When reduced to electronic components, the use profiles result in chronograms or templates (inrush current, nominal, maximum, dysfunctional, voltage drop, starting voltage, response time, rise time, etc.) and are characterized by static (extreme values), dynamic (cyclage/fatigue) or aggravating combinations (couplings) constraints. It should be noted that other types of stresses can/should be considered in relation to thermal and/or hygrometry and even other forms of significant stress.
3. At the component level. From the knowledge of the stresses suffered by the component, it is a question of determining the dysfunctional influence, i.e. the level of damage resulting from it. This implies, on the one hand, knowing or characterizing the failure physics of the component and, on the other hand, identifying its dynamics according to the stresses applied to it and ageing phenomena.
4. In the ascending direction: component system. The process of increasing the reliability of the component to that of the system will require the upward aggregation of information from analyses, combinations and interpretation of the performance over time of the elementary components, subsystems and finally the system according to the characteristic stresses of each level of decomposition; the objective is to move from component reliability to system reliability or better, from the performance of the component to the performance of the system if there are degraded operating modes.

Name of industrial partner	Alstom Transport
Role of the industrial partner in the internship project	The work will be supervised and implemented within the Alstom company in France. Some contacts are likely to be established with the subsidiary of the company in Australia located in Sydney.
Main contact at the French industrial partner	Clair Fournier
Targeted Australian university	Any

Expected profile of applicant

Level of study	Master Degree
Discipline	Industrial Engineering or Electrical Engineering
Required qualities, knowledge and skills	Must have a certain level of experience in one of the fields related to the expected work. The candidate will in particular have knowledge in mechanical and/or electronic skills.
Other specific eligibility criteria	The applicant also has a good ability to communicate written and oral in English. Fluency in French language is not mandatory.

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