ECL_LTDS_Sinou_02

PhD Proposal 2017

School: Ecole Centrale de Lyon	
Laboratory: Laboratoire de Tribologie et Dynamique des Systèmes LTDS UMR 5513	**Web site: http://ltds.ec-lyon.fr/spip/**
Team: Dynamique non-linéaire, Incertitudes et Systèmes avec Interfaces	**Head of the team: Prof. J-J. Sinou**
Supervisor: Prof. J-J. Sinou Dr. L. Nechak	**Email:** jean-jacques.sinou@ec-lyon.fr Phone: +33 (0)4 72 18 64 66 Personal Homepage: http://jean-jacques.sinou.fr
Collaboration with other partner during this PhD: In France:	**In China:**

Title: Noise, Vibration and Harshness (NVH)
Scientific field: mechanical systems and structural dynamics.
Key words: structural dynamics; friction; uncertainties; nonlinear vibrations; automotive systems.

Details for the subject:

Background, Context:

The incorporation of nonlinear phenomena or uncertainties in complex mechanical systems and more specifically in the field of friction-induced vibration presently gives rise to major problems during the design of industrial structures.
It is clear that optimizing mechanical structures with respect to their vibration behaviors requires a detailed understanding of the structures along with highly-refined models. Including the set of nonlinear elements that play a predominant role in the dynamic behavior of structures, in addition to elements that induce uncertainty, proves to be essential not only for studying the dynamic behavior of systems, but also for devising robust and reliable system designs able to withstand the range of loadings potentially applied.
Experience has shown that although research into the nonlinear dynamic behavior of structures and the inclusion of dispersion in mechanical systems constitute two distinct subjects often treated separately, the study of nonlinear dynamic behavior in systems containing uncertainties is not straightforward and, as such, has been heavily marginalized.
The introduction of robust and reliable nonlinear methods, that offer considerable reductions in computation time while guaranteeing a high-quality estimation of the nonlinear dynamic behavior of mechanical systems with uncertainties, is still a wide open topic. It allows analyzing the behavior of mechanical structures via models and numerical simulations to optimize their performance and predict their lifetime.
More specifically, it can be noted that the treatment of uncertainty for self-excited nonlinear structures subjected to friction-induced vibration is a very difficult problem and not really discussed at the present time.

Friction-induced noise and nonlinear vibration in automotive engineering sector

Research subject, work plan:

This study consists of considering the dispersion problems encountered in various physical parameters exerting an influence on both the stability and global nonlinear behavior of unstable nonlinear dynamic systems with friction.
The major engineering and scientific objectives are:

- inclusion of uncertainties in self-excited nonlinear systems (with a specific attention for friction destabilized systems by taking into account realistic tribological laws at frictional interfaces)
- uncertainty effects on the variability of friction-induced noise and vibrations
- nonlinear methods for calculating the transient or/and quasi-periodic responses of self-excited vibration,
- optimizing such systems from a dynamic behavior perspective by means of proposing robust and reliable designs,
- modeling problems facing the field of nonlinear mechanical engineering given the new emphasis on safety, comfort and competitiveness.

Work plan:

1- Stability analysis and self-excited vibration in a deterministic case
   a. Friction-induced vibration with specific friction laws
   b. Sensibility analysis
   c. Meta-models for the prediction of the occurrence of squeal noise

2- Uncertainty effects and propagation of uncertainty
   a. Physical parametric studies on the stability analysis
   b. Variability of the nonlinear responses

3- Efficient modal reduction for the prediction of squeal noise
   a. Stability analysis and self-excited vibration in a deterministic case
   b. Stability analysis and self-excited vibration with uncertainties
   c. Sensibility analysis with physical parameters

Previsional Schedule:

	Year 1		Year 2		Year 3	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6
Stability analysis and self-excited vibration in a deterministic case						
Uncertainty effects and propagation of uncertainty						
Efficient modal reduction for the prediction of squeal noise						

References:

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