PhD thesis October 2023

Friction induced vibrations: coupled experiments/modelling study of the triggering conditions by enrichment of the interface parameters

Context

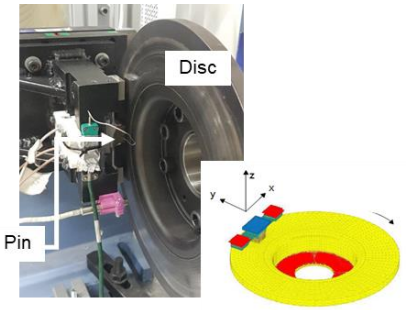
Vibration problems in structures initiated by frictional contacts are encountered in many applications such as braking systems, bio-medical joints, etc. In addition to the vibratory consequences that can affect the operation of these systems, these phenomena influence the tribological mechanisms located in the contact interface and can lead to multiple nuisances: noise (squealing for example), excessive wear and associated pollutant emissions (particles…), etc. Several difficulties make this problem complex: the non-linearity induced by the contact, the scale interactions between system and contact interface and the tribology-dynamics coupling.

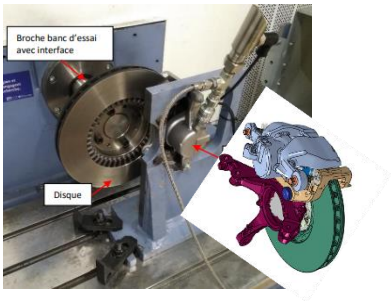
Even if recent advances have been made on the understanding of friction-induced vibrations, especially on the identification of excited frequencies, the conditions of their triggering remain unknown. The aim of this work is to understand these conditions of occurrence by considering the coupling tribology-dynamics through the enrichment of the description of the contact interface in the modeling of the vibratory behavior and conversely to consider the effect of vibrations on the tribological circuit.

Work programme

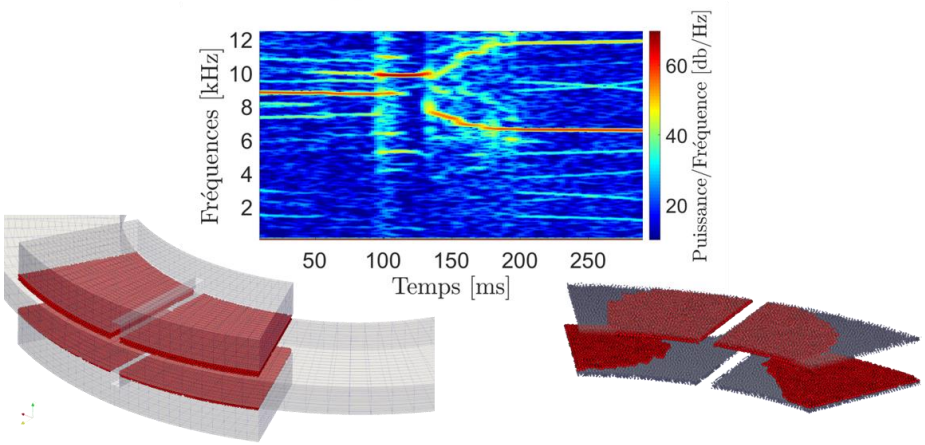
The strategy is based on experiments with original instrumentation (contribution of LaMcube), coupled with numerical simulations also innovative (contribution of LAMIH).

The experiments are carried out on simplified geometries (pin-on-disc type) and complex systems (braking application) with a very rich multimodal instrumentation (mechanical, thermal, acoustic, tribological...) allowing an in-situ follow-up of the evolution of key parameters of the contact interface.





In parallel, the modeling of the vibratory behavior will integrate a description of the local excitation mechanisms inaccessible by the measurement and made possible by a coupling of the FEM-DEM methods.



Dynamical FEM-DEM brake squeal simulation

The applicative consequences are numerous and the proposed methodology is generic, a precise focus on squeal noise in braking systems will be treated in this work.

Required profile

Master's student or engineer, with a solid knowledge in structural vibrations, notions in tribology, and a mastery of numerical tools such as finite elements (Abaqus) and programming tools (Matlab, Python, C++). The PhD student will register at Lille university at the start of the 2023 academic year. The gross monthly salary will be around 2500€.

Contact

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Some references of research teams

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