Validation of a test for measuring fretting contact damage using X-ray tomography

Camille Gandiolle*†[1], Zakariae Maazaz[1,2], Youssef Younes[1], Benjamin Smaniotto[1], Jean-Christophe Teissedre[2], and Pierre Arnaud[2]

[1]Laboratoire de Mécanique Paris-Saclay – Université Paris-Saclay, CentraleSupélec, ENS Paris-Saclay, CNRS, LMPS - Laboratoire de Mécanique Paris-Saclay, 91190, Gif-sur-Yvette, France. – France

[2]Centre des Matériaux – Mines ParisTech, Université PSL, Centre des Matériaux(CMAT), CNRS UMR 7633 BP 87, F-91003 Evry Cedex, France – France

Abstract

Mechanical assemblies are often subjected to vibrations that generate micro-friction at the contacts: fretting. These slight displacements can lead to cracking and/or wear, reducing the service life of the assembly. Numerous models and tests exist to predict contact life, but there is still considerable room for improvement, based on a poor understanding of what happens in the contact. Indeed, most models use a continuous, homogeneous interface, whereas the actual contact area, pressure distribution and friction coefficient depend on the local state of the contact. Access to the evolution of the interface over time, as well as to its damage through wear and cracking, is therefore necessary to further the understanding and simulation of mechanical assemblies. In-situ tomography testing would provide access to this information. The aim of this work is to present the development and validation of an in-situ fretting test for X-ray tomography. It has been designed to quantify local information (friction, stiffness, slip) during loading, thanks to sensors. The main challenge is ensuring quantifiable contact forces, while placing as little material as possible at the source to ensure sufficient transmission, while at the same time being representative of industrial contacts. The set-up has been validated against the fretting vibration test under controlled load, with many cycles. It also makes it possible to reproduce the damage generated on conventional macroscopic test benches. The final design combines technical and material choices that enable good reconstruction. The first deformation fields, obtained from an in-situ fretting test, are proposed and compared to FE simulation. The local coefficient of friction is fitted using contact shear displacement.

*Speaker

†Corresponding author: camille.gandiolle@centralesupelec.fr