3D deformation fields in fretting contact using X-ray tomography

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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. An in-situ tomography test has been designed with this aim. It is instrumented to quantify local information (friction, stiffness, slip) during loading. It 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. With this innovative in-situ test, the first 3D deformation fields were obtained for fretting contact and compared to FE simulation. The local coefficient of friction is fitted using contact shear displacement.

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