Micro-mechanical characterization of solid 3rd bodies created in dry lubricated contact within space mechanisms
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Lubricating space mechanisms is a great challenge as lubrication must be sustained in several environments during mechanism life (up to 15 years once in space). Lubricants must face humid air, dry nitrogen and simulated vacuum environments as well as gravity on Earth; high stress mechanical environment during launching; vacuum, radiations, weightlessness in space, etc. Dry lubricants are often used over oil or grease lubricants as they offer a wider range of temperature working conditions and a lower risk of contaminating surrounding instruments (especially optics). Furthermore they can be used at very low speed and are more flexible in term of accelerated testing. However, until now, no model can predict their behaviour reliably.

Previous studies focusing on the dry lubrication efficiency of coatings and composite materials used for space applications showed that low friction and long wear life is reached only when a 3rd body layer is formed between the two bodies in contact. Elements comprising this 3rd body come from the material initially in contact (via detachments of particles mainly) and the surrounding environment. A complex physico-chemical rearrangement is then mechanically induced under friction to create the 3rd body layer with a specific rheology and with the ability to slide inside the contact. The rheology provides cohesion and ductility which enables plastic flow inside the contact to help the accommodation of relative velocities. The quantification of the rheology of the 3rd body and of the interaction between materials is a key to quantitative prediction.

The project aims to develop experimental tools to measure the mechanical properties of the 3rd body to characterise its rheology and inform a numerical model developed in parallel. The MEng student will take part in the definition and testing of an experimental protocol to measure the interaction between the different bodies used and created inside a contact representative of the real application. The work will notably focus on:

– defining a reliable protocol to measure those interaction in controlled environments,
– perform the measurements and post treat the data to discuss them regarding the application and the history of the contact, and regarding the numerical model.

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Research area: Mechanics and Materials