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MIKROTRIBOLOGIE CENTRUM µTC

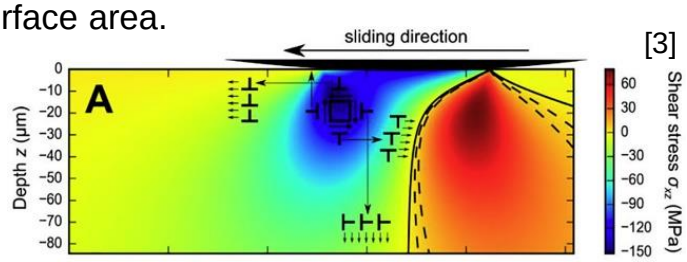
IAM Institute for Applied Materials

BACHELOR'S THESIS / MASTER'S THESIS / HIWI

Simulation of additively manufactured materials under tribological load

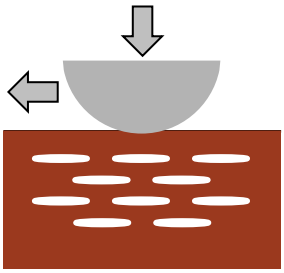
Background

About 23% of the world's energy demand currently stems from friction and wear in mechanical systems. By optimizing the materials, surfaces and lubrication used, these losses can be reduced by up to 40% in the long term and thus make a significant contribution to the sustainable use of resources and the reduction of emissions. [1]
In metals, surface and sub-surface microstructural alternations have been deemed the major path for frictional energy dissipation, and therefore, these hidden transformations hold the key to making metals more wear-resistant and the friction of a tribological pairing tunable. Additive Manufacturing could enable altering the formation of these microstructural changes by introducing structures in the sub-surface area.
Knowledge about the movement of dislocations and therefore the stress field in the tribological contact is necessary in order to understand the formation of the microstructural changes.



[3]

In basic approaches the analytical solution of the stress by Hamilton [2] is used to attempt to explain the microstructural changes [3].
More realistic material models could lead to a better understanding of the stress field in the contact. Additive manufactured structures could then be used to interfere with the stress field. By Simulating the tribological loading of such additively manufactured structures a systematic design would be enable.



Objectives

The objective of this study is to set up a simulation (FEM/CCD) of a sliding spherical contact with subsurface structures. The goal of this simulation is to evaluate the changes in the stress field of the tribological contact due to structures like pores with different geometries.

Requirements

- Basic knowledge and interest in materials science and mechanics are needed.
- Simulation knowledge with the finite element method is an advantage but not mandatory.

Possible start: immediately

Contact

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References: [1] Holmberg, K., Erdemir, A., Friction 5 (2017): 263–284.
[2] G. M. Hamilton, Proceedings of the Institution of Mechanical Engineers1 97.1 (1983): 53–59.
[3] C. Greiner et al., *Scripta Materialia* 153 (2018): 63-67.