The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

SIMULATION OF NON-ROUND PARTICLES IN TRIBOLOGICAL THREE-BODY SYSTEMS

Raphael Bilz[1] **and Kristin M. de Payrebrune**[2]

[1] Institute for Computational Physics in Engineering, Technische Universität Kaiserslautern, Erwin-Schrödinger-Str. 56, 67663 Kaiserslautern, Germany, raphael.bilz@mv.uni-kl.de

[2] Institute for Computational Physics in Engineering, Technische Universität Kaiserslautern, Erwin-Schrödinger-Str. 56, 67663 Kaiserslautern, Germany, kristin.payrebrune@mv.uni-kl.de

Keywords: *Particles, Contacts, Mechanical Process Engineering, Tribological Contacts, Computing Methods*

Particles are present in many technical applications. Especially when particles enter the gap between the contact interfaces of two components moving relative to each other, these particles can strongly influence the system behavior. In this context, the focus is often on the investigation of wear and damage, for example, in order to be able to control the lifetime of gears or moving bearings in sandy environments [1]. In addition to such undesirable phenomena, however, there is also the targeted use of hard particles, for example in the lapping process. In lapping, hard particles are intentionally inserted between a lapping disc and the workpiece surface to be processed in order to cause material removal with the help of the particles and to improve the morphology of the workpiece surface for certain applications [2].

Many simulations of such tribological systems are based on the assumption of round particles [3, 4]. However, both, size and shape of the particles have an essential effect on the result and system behavior. Blunt particles and angular particles result in different surface topographies [5] and the dynamic system behavior can have a velocity dependence, which is related to the particle size and shape [6].

Here, an approach is presented in which arbitrarily shaped particles in contact are studied a priori using the finite element method by performing indentation simulations for various particle orientations. Based on the results, an orientation-dependent particle model is created for higher-level simulations of particles in narrow gaps. This modular design allows direct control in the implementation of phenomenological effects and new insights into the behavior of such systems.

REFERENCES

[1] M. Woldman, *An experimental and theoretical investigation into three-body abrasive wear*. University of Twente, 2014.

[2] F. Klocke, *Fertigungsverfahren 2: Zerspanung mit geometrisch unbestimmter Schneide*. Deutschland: Springer Berlin Heidelberg, 2018.

[3] M. Khonsari, *On the modeling of multi-body interaction problems in tribology*. Wear, Vol. **207**(1–2), pp. 55–62, 1997.

[4] W. Wang, Y. Liu, G. Zhu and K. Liu, *Using FEM–DEM coupling method to study three-body friction behavior*. Wear, Vol. **318**(1–2), pp. 114–123, 2014.

[5] G. Stachowiak, G. Stachowiak, *The effects of particle characteristics on three-body abrasive wear*. Wear, Volume **249**(3–4), pp. 201–207, 2001.

[6] R. Bilz and K. M. de Payrebrune, *Investigation of the influence of velocity in a tribological three-body system containing a single layer of rolling hard particles from a mechanical point of view*. Tribology International, Vol. **159**, pp. 106948, 2021.