Modelling and simulation of particles in contact

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ABSTRACT

In many applications, particles are inherent and influence contacts, such as in manufacturing processes or in process engineering.

In mechanical process engineering, particles are the product that must be handled and transported, while in many manufacturing processes abrasive particles serve as cutting tools, e.g. in lapping or grinding [1], without them machining would not work. In addition, particles are an important part of the tribotechnical system in many contact scenarios and significantly influence the system properties, e.g. when emptying silos or conveying granular media [2], when tyres come into contact with soil [3], when seals are used in particle-contaminated environments, e.g. in mining or flood protection, or when brakes are used with abrasive residual particles.

Friction-induced vibrations, unstable process conditions [4], unexpected sticking or agglomeration effects may occur [5], affecting operational safety, system lifetime or handling of granular medium. For all these exemplary contact situations, successful mechanical modelling and simulation of the particle behaviour is essential to understand and optimise the processes.

The focus of this Minisymposium is set on the mechanical modelling and simulation of:

* Agglomeration of particles and formation of patches
* Vibration induced by particle contacts
* Movement of particles within the contact
* Particles between hard and soft bodies, such as rubber
* Characterisation of the contact properties of particles
* Adhesion behaviour of particles
* Validation of models with experimental investigations

While processes without solid or loose particles allow the contact scenarios to be described by the kinematics of the bodies in contact, the consideration of particles or the description of the interaction of numerous particles makes the mathematical modelling considerably more complex. Statistically distributed contacts with different local contact conditions, the motion description of granular media considering adhesive bonds or wear caused by geometrically complex particles are examples for which new mathematical forms of description are required or established methods, such as DEM or PFEM, must be combined with extended algorithms.

This Minisymposium aims to bring together experts from both computational mechanics and experimental mechanics with the common aim of developing models and methods for the numerical simulation of particles in contact and analysis of engineering applications.

**REFERENCES**

[1] K. M. de Payrebrune and M. Kröger, “Reduced models of grinding wheel topography and material removal to simulate dynamical aspects in grinding”, Int. J. Adv. Manuf. Technol., Vol. 88, pp. 33-43, (2017).

[2] T. Falke, K.M. de Payrebrune, S. Kirchhof, L. Kühnel, R. Kühnel, T. Mütze and M. Kröger, “An alternative DEM parameter identification procedure based on experimental investigation: A case study of a ring shear cell”, Powder Technology, Vol. 328, pp. 227-234, (2018).

[3] D. Besdo, B. Heimann, M. Klüppel, M. Kröger, U. Nackenhorst and P. Wriggers, “Elastomer Friction: Theory, Experiment and Simulation”, Lecture Notes in Applied and Computational Mechanics, Vol. 51, Springer Verlag, (2010).

[4] R. Bilz, 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).

[5] M. Kröger and S. Nitzsche, “Adhesion of Rubber on smooth and rough Surfaces”, Kautschuk Gummi Kunststoffe, No. 4, pp. 28-31, (2018).