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### Numerical modeling of the mechanical interaction of a bacterium

The behavior of non-biological spherical particles can be readily modeled with the discrete element method. The size of the particles thereby plays an important role in particle or particle system behavior. For micron-sized particles the attractive force becomes dominant, thus specific knowledge is needed regarding it. This knowledge can be applied not only for non-biological, but also for biological similar sized objects, such as cells. This can extend the implementation, the understanding and possible applications of the discrete element method even up to the molecular dynamics level. In this work, we introduce models for cell interaction, basing on experience from modeling the interaction of ultrafine particles. The cell is thereby considered as a colloid particle, where an idealization with continuum mechanics is applicable. The model parameters for the cells are taken from known physical experiments performed with spherical *S. aureus* bacteria. The presented model is universal, and can be applied for the modeling of the dynamics of possibly other cell types as well. The investigation of the dynamics of a single bacterium may help to understand the behavior of a system of bacteria (e.g. biofilm formation) as well as the transmission of infections in the air. One of the important factors influencing the stability of a bacterial structure, but also important in the context of an infection is the adhesion force. Detailed results on the sticking process of a bacterium are presented. A characterization of the influence of repulsive and attractive forces on the bacterium is given. The obtained results are shown in terms of force displacement diagrams as well as a function of the interaction and sticking time history. For the modeling of the system behavior the sticking process of 10,000 bacteria is considered.



Figure 1: Scheme for the motion of the bacterium close to the wall. Adhesive viscous elastic-plastic sticking process model applied.

#### Biography

Raimondas Jasevičius has completed his PhD from Vilnius Gediminas Technical University (VGTU) and Post-doctoral studies from Vilnius University, Lithuania. He is a Senior Researcher, Institute of Mechanics and is an Associate Professor, Department of Printing Machines, VGTU. He has built an adhesive dissipative interaction model after years of experience in research with Otto von Guericke University and Berlin Technical University, Germany. He has more than 18 published articles in reputed journals.

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