Technology on our fingertips

July 29 2019, by Elif Yilmaz

Haptics. Credit: Koc University

Just a few years ago, "haptics" (interaction by touching) was a subject studied in only a few labs around the world. As it became more widely used in touch screens and in the automotive industry, the number of researchers pursuing this field also grew larger, naturally. There is much attention on surface haptics in particular. The main objective in this area

is to provide tactile feedback to the user through frequently used touch screens in mobile devices, tablets, and kiosks.

Prof. Çağatay Başdoğan of Koç University Mechanical Engineering Department, and Director of Mechatronics and Robotics Laboratory, and his team lead one of the top research groups in haptics. Recently, an article was published in *PNAS* (*Proceedings of the National Academy of Sciences*), in which they put forward a new approach.

In their *PNAS* article, they explain the reasons why we don't feel anything when we touch a surface with our finger but do feel friction when we move our finger on the surface. Their starting point is, "Something must be changing so that we perceive it as friction." Prof Başdoğan and his team joined forces with Dr. Bo Persson, who is a world-renowned expert in the field of friction and is carrying out his studies in Germany's Peter Grünberg Institute. The subject they focused on is the "actual" contact area of the finger. Since a real contact means a nano-scaled adhesion, our finger can easily separate from the surface in the normal direction while it moves but faces a greater force in the direction of friction. This is due to an increase in adhesion and pulls effects by the changing air gap between the surface and the finger during finger movement. This reflects the user as a change in the friction force. What makes the work of Başdoğan and his team out of the ordinary is that they have demonstrated the effect of the finger's real contact area to the physics of the actual movement.

Başdoğan and his team use a mean field theory based on multiscale contact mechanics to investigate the effect of electroadhesion on sliding friction and the dependency of the finger–touchscreen interaction on the applied voltage and other physical parameters. They present experimental results on how the friction between a finger and a touchscreen depends on the electrostatic attraction between them. The proposed model is successfully validated against full-scale (but

computationally demanding) contact mechanics simulations and the experimental data.

The study shows that electroadhesion causes an increase in the real contact area at the microscopic level, leading to an increase in the electrovibrating tangential frictional force. They find that it should be possible to further augment the friction force, and thus the human tactile sensing, by using a thinner insulating film on the touchscreen than what is used in current devices.

More information: Mehmet Ayyildiz et al. Contact mechanics between the human finger and a touchscreen under electroadhesion, *Proceedings of the National Academy of Sciences* (2018). DOI: 10.1073/pnas.1811750115

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