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Seminar über Ultrafast Science and Technology

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Titel: Mechanical contact of skin and textiles: THz imaging of the interface

In medical applications, contact of patients' skin with body monitoring devices and bed sheets cannot be avoided. Mechanical properties at the interface, namely the surface texture and the moisture con-tent, are responsible for reactions causing skin irritations. Theoretical models for friction and contact behavior can estimate the real contact area and the intrinsic shear strength as a function of the contact pressure. Nevertheless, experimental in situ observations which can validate such models are missing. Peculiar properties of matter at THz frequencies make THz radiation a suitable probe for its non-ionizing nature. THz waves are transmitted by many non-conducting materials like textiles, reflected by skin and absorbed by interfacial water, thus allowing the investigation of hidden biomechanical inter-faces in a safe way for the human body. Therefore, we are developing an experimental setup based on THz digital holography [1, 2], which is a full-field, continuous-wave imaging technique preserving phase sensitivity and delivering images with a single-shot acquisition. Topographic reconstructions can be ob-tained with a resolution below the radiation wavelength. Reconstructions of fingertip replicas in transmission and in reflection will be shown. A lateral resolution of 200 ?m and a depth resolution of 20 ?m were achieved [3], which are enough to resolve the micro-scopic ripple structure of skin. Finally, the capability of our technique to retrieve profiles of objects hid-den behind THz-transparent samples will be discussed. We present a method for the separation of multiple interfering signals in the framework of THz digital holography [4]. A metallic resolution target behind a Teflon plate was successfully reconstructed. This study is essential since it prepares future ex-periments where a textile patch is inserted between a skin replica and a Teflon plate, mimicking a real life contact situation.
1. P. Zolliker, and E. Hack, "THz holography in reflection using a high resolution microbolometer array," Optics express 23, 10957-10967 (2015).
2. E. Hack, L. Valzania, G. Gäumann, M. Shalaby, C. P. Hauri, and P. Zolliker, "Comparison of thermal detector arrays for off-axis THz holography and real-time THz imaging," Sensors 16, 221 (2016).
3. E. Hack, and P. Zolliker, "High-resolution terahertz holography for profilometry in transmission," in PhotoMechanics Conf(2015), pp. 116-118.
4. L. Valzania, P. Zolliker, and E. Hack, " Topography of hidden objects by analysis of multiple-beam interference patterns with THz digital holography" (to be submitted)

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