

## The Touch Sensation: Ageing and Gender Influences

**Authors :** A. Abdouni, C. Thieulin, M. Djaghloul, R. Vargiolu, H. Zahouani

**Abstract :** A decline in the main sensory modalities (vision, hearing, taste, and smell) is well reported to occur with advancing age, it is expected a similar change to occur with touch sensation and perception. In this study, we have focused on the touch sensations highlighting ageing and gender influences with in vivo systems. The touch process can be divided into two main phases: The first phase is the first contact between the finger and the object, during this contact, an adhesive force has been created which is the needed force to permit an initial movement of the finger. In the second phase, the finger mechanical properties with their surface topography play an important role in the obtained sensation. In order to understand the age and gender effects on the touch sense, we develop different ideas and systems for each phase. To better characterize the contact, the mechanical properties and the surface topography of human finger, in vivo studies on the pulp of 40 subjects (20 of each gender) of four age groups of  $26 \pm 3$ ,  $35 \pm 3$ ,  $45 \pm 2$  and  $58 \pm 6$  have been performed. To understand the first touch phase a classical indentation system has been adapted to measure the finger contact properties. The normal force load, the indentation speed, the contact time, the penetration depth and the indenter geometry have been optimized. The penetration depth of a glass indenter is recorded as a function of the applied normal force. Main assessed parameter is the adhesive force  $F_{ad}$ . For the second phase, first, an innovative approach is proposed to characterize the dynamic finger mechanical properties. A contactless indentation test inspired from the techniques used in ophthalmology has been used. The test principle is to blow an air blast to the finger and measure the caused deformation by a linear laser. The advantage of this test is the real observation of the skin free return without any outside influence. Main obtained parameters are the wave propagation speed and the Young's modulus  $E$ . Second, negative silicon replicas of subject's fingerprint have been analyzed by a probe laser defocusing. A laser diode transmits a light beam on the surface to be measured, and the reflected signal is returned to a set of four photodiodes. This technology allows reconstructing three-dimensional images. In order to study the age and gender effects on the roughness properties, a multi-scale characterization of roughness has been realized by applying continuous wavelet transform. After determining the decomposition of the surface, the method consists of quantifying the arithmetic mean of surface topographic at each scale SMA. Significant differences of the main parameters are shown with ageing and gender. The comparison between men and women groups reveals that the adhesive force is higher for women. The results of mechanical properties show a Young's modulus higher for women and also increasing with age. The roughness analysis shows a significant difference in function of age and gender.

**Keywords :** ageing, finger, gender, touch

**Conference Title :** ICBBB 2016 : International Conference on Biotribology, Biomechanics and Bioengineering

**Conference Location :** Amsterdam, Netherlands

**Conference Dates :** December 01-02, 2016