

## THE SENSE OF TOUCH — AN UNDERESTIMATE INFORMATION CHANNEL\*

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*Предмет на настоящата статия е коожната чувствителност, един често пренебрегван сензорен вход. След кратък преглед на анатомичните структури, осъществяващи този вид възприятие, се изтъква необходимостта от проучвания в областта на тактилното възприятие. Разгледани са основните насоки в изследователските търсения в момента - използването на тактилната чувствителност като диагностичен критерий и рехабилитационно средство при пациенти с мозъчни увреди или тежки травми на ръцете и значението на тактилните програми за стимулация на преждевременно родени деца. Отделено е внимание и на практическото приложение на тактилната чувствителност за производство на протези, компенсиращи дефекти в зрителното и слуховото възприятие, както и за конструиране на сензорни системи за новите поколения роботи.*

### 1. Introduction

This paper is about the sense of touch. The coverage here runs from brief anatomy and main topics in touch research to the use of scientific results in solution of applied problems.

Studies of the sense of touch are part of the numerous investigations about tactile modality. The latter includes all body feelings — the skin senses of touch, pressure, pain, temperature, itch, vibration, and tickle, as well as the senses of joint and limb position, muscle tension and viscera sensations. Different parts of tactile modality are under the scope of study in medicine, physiology, psychophysiology, neurology, gerontology and psychology. Nevertheless, this is the sensory channel, which is often underestimated, when the processing of information is considered.

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Before going further, it is necessary to underline that several synonyms are used in the literature. These are the words tactile, haptic and touch. *Tactile* comes from the Latin verb *tactilis* [*tangere*, pp. *tactus*] = to touch. *Haptic* has a Greek origin. The Greek word *haptēin* means “related to or based on the sense of touch”. *Touch* comes from the old French. The definitions of touch in the dictionaries are: 1) the action or the act of touching and 2) examination by feeling, especially of a cavity of the body, palpation.

In summary tactile, haptic and touch do not differ significantly and the use of one of them often depends on authors' preferences.

The most often studied part of tactile modality, especially in the psychological investigations, is the sense of touch. It includes cutaneous sensitivity and kinesthesia. (Kinesthesia or kinesthesia is the sense of muscular effort that accompanies a voluntary motion of the body.) Further on, the text will refer only to the sense of touch and especially to the cutaneous sensitivity, because of the reasons: a) it is impossible to review all the important and interesting topics connected, with tactile research in a single paper; b) most research on tactile modality focused on the sense of touch and particularly on the palm and palmar aspects of the fingers, and c) the author's interests and research efforts are directed towards studying cutaneous sensitivity.

## **Anatomy — short overview**

### *Skin — the touch sensory organ*

The skin covers the entire body surface. It is the largest organ of the body and it is one of the most complex. The total area of the skin of an average-size adult is about 1.8 m<sup>2</sup>, which is almost 1000 times the area of the retinas. The skin has a density of 1250 kg/m<sup>3</sup> or in the upper case it weights about 5 kg (Robbins, 1991). Two major types of skin are described — the glabrous skin, which covers the palm and the sole and the hairy skin, that contains hair follicles and hairs that are more or less visible. The skin is a layered tissue consisting of epidermis, dermis and subcutaneous fatty tissue. The cutaneous (tactile) sensory nerves branch through the dermis and terminate in the dermis and epidermis.

### *Tactile receptors*

Four types of tactile receptors or tactile units are found in the human skin. They are primary afferent neurons with terminal sensory endings. Two types of receptors, Meissner and Pacinian, are called “fast” because they respond only to the transient phase(s) of stimulation. The other two types — Merkel and Ruffini receptors, show a sustained discharge and are labeled “slow” (Kaas, 1991; Darian-Smith, 1984). Meissner corpuscles or fast-adapting type I (FAI) receptors are ovoid-shaped capsules. Most dense in the glabrous fingertips, they are thought to be important in discrimination of textures and the sensation of flutter. Pacinian corpuscles or fast-adapting type II (FAII) receptors are relatively large onion-shaped structures, located deep in the dermis and subcutaneous tissue. Extremely sensitive, they appear to be the only receptors capable of subserving the sensation of high-frequency vibration. Merkel cell neurite com-