

Preface

Touch is the ability to understand the world through physical contact. The noun “touch” and the verb “to touch” derive from the Old French verb “tochier”. Touch perception is also described by the adjectives *tactile*, from the Latin “tactilis”, and *haptic*, from the Greek “haptós”. Academic research concerned with touch is also often described as *haptics*.

The aim of *Scholarpedia of Touch*, first published by Scholarpedia (www.scholarpedia.org), is to provide a comprehensive set of articles, written by leading researchers and peer reviewed by fellow scientists, detailing the current scientific understanding of the sense of touch and of its neural substrates in animals including humans. It is hoped that the encyclopedia will encourage sharing of ideas and insights between researchers working on different aspects of touch in different species, including research in synthetic touch systems. In addition, it is hoped that the encyclopedia will raise awareness about research in tactile sensing and promote increased scientific and public interest in the field.

Our encyclopedia assembles a state-of-the-art understanding of the sense of touch across a broad range of species from invertebrates such as stick insects and spiders, terrestrial and marine mammals, through to humans. The different contributions show not only the varieties of touch—antennae, whiskers, fingertips—but also their commonalities. They explore how touch sensing has evolved in different animal lineages, how it serves to provide rapid and reliable cues for controlling ongoing behaviour, how it develops, and how it can disintegrate when our brains begin to fail. In addition to analysing natural touch, we also consider how engineering is beginning to exploit physical analogues of these biological systems so as to endow robots, and other engineered artefacts, with rich tactile sensing capabilities.

Scope and Structure

Following an introductory chapter—The World of Touch—our encyclopedia is structured into four parts:

- **Comparative Touch** There are a large number of specialist tactile sensory organs in the animal kingdom. This part contains articles on animal species that exhibit interesting or exceptional tactile sensing abilities. We particularly focus on antennal systems in insects, and on vibrissal systems in both terrestrial and marine mammals.
- **The Psychology of Touch** The study of human cutaneous touch has a rich and long history in psychology and psychophysics. The pioneering studies of Ernst Weber (1795–1878) distinguished different forms of touch—pressure, temperature, and pain—all of which are separately considered in our encyclopedia along with dynamical (effortful) touch, tactile perception of force, and relevant forms of interoception (internal sensing) and proprioception (sense of body position). A particular focus of recent research has been towards the combination of tactile sensing with manipulation and grasp in the human hand. Alongside the study of healthy touch, this part also considers research on touch disorders, loss of tactile acuity with ageing, and the phenomenon of phantom touch.
- **The Neuroscience of Touch** A scientific understanding of the biological substrates for tactile sensing is beginning to emerge at all levels from the sensory periphery through to the somatosensory and multimodal areas of cortex. Perhaps more than any other sensory modality, tactile sensing is critically dependent on the movement of the sensing apparatus, therefore touch is increasingly studied from an active perception perspective—understanding active touch (in contrast to passive touch) as an intentional, information-seeking activity that combines sensing with actuation. The investigation of the sensorimotor control loops involved in mammalian active touch has been significantly advanced by the availability of the rodent vibrissal sensory system as an animal model. This part therefore combines studies in both primates (including humans) and rodents to show how neurobiological research is beginning to demonstrate an in-depth understanding of tactile sensing systems in mammals.
- **Synthetic Touch** Touch sensing is giving rise to a range of exciting new technologies. This part highlights some of the most promising tactile sensors for robots and haptic displays for the visually-impaired, through to virtual touch systems that can allow the extension of touch, through telecommunication technologies, as a modality for communication.

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