pressure inside the pressure chamber which is measured by the mechanosensitive neuron.

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A7.20
The morphology and mechanics of *Orthopteroidea* mechanosensors

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Crickets, and other orthopteroidea, possess one of the most sensitive hair-based sensory systems found in nature. The array of mechanosensors, located on the cerci, can “measure” small changes in air flow, enabling the cricket to detect and escape from approaching predators. The morphology and mechanics of the air-flow sensory system has been studied in order to identify common principles underlying the use of such a solution in nature and to make those principles available for the design of bio-inspired engineering applications.
Morphological details about the single hair and array system, were determined using a combination of imaging techniques that include Scanning Electron Microscopy and Confocal Microscopy. Mechanically, the hair-socket arrangement behaves as an auditory system, able to respond to external vibrations at up to 10 kHz. Scanning Laser Vibrometry (SLV) was used to determine the velocity and displacement of the hair in response to a white noise “chirp“ produced through a vibrating membrane. The deflection patterns observed in the hairs appear to be mixed-modes showing bending and rotation, particularly at low frequencies, and an effect of hair length was also observed. Vibration peaks presented by the stimulus plate have been clearly detected by the hairs and the measured angular displacement of the hairs fell between 0.005 and 0.01°. The ability to artificially replicate this highly sensitive system, will open the door to engineering solutions such as MEMS hairs. Applications for this developing technology include cochlear implants and air velocity detectors with a high degree of in-built redundancy.

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A7.21
Opportunities and challenges for obtaining effective lubricated engineering systems inspired by the lubrication of synovial joints

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The application of tribology in medicine and biology is a growing and rapidly expanding field, mainly driven by the increasing need for the development of prosthetic devices to replace diseased tissues and organs. In this study biomimetics and bioinspiration of effective natural lubricated systems and formation of unique tribologic materials are applied towards improvement of engineering tribology systems. This is of great importance now and in the future since lubricating surfaces to minimise wear and friction using chemical species which have no harmful effects on the environment is an immense challenge for engine oil formulators, the tier two components suppliers and the original equipment manufacturers (OEMs). Additives to control friction and reduce wear are commonly used and these function by forming a nanometre scale film (the tribofilm) on rubbing or sliding surfaces. This film has several key features: it forms spontaneously on rubbing, it has a nanostructured composition, it is self-healing and it is smart. To achieve all of these functions from “green” compounds is an immense challenge for lubricant additive formulators.
As a novel approach to lubricant additive design we are currently investigating the feasibility of using a biomimetic approach to develop novel lubrication strategies and in this paper we will focus on the potential of development of effective lubricated system inspired by the lubrication of natural synovial joints.
Natural synovial joints are able to articulate freely with extremely low friction and wear for over 75 million loading cycles in a lifetime. In this paper the joint biomechanics, properties of the materials and fluids involved and challenges related to the transfer of obtained knowledge towards producing equivalent engineering systems will be discussed. The material properties, surfaces and interfaces needed to replicate the functionality mode of this system will also be discussed.

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A7.22
Bio-inspired medical technology

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The department Bio-Mechanical Engineering of Delft University of Technology uses nature to develop novel surgical instruments for medical applications such as minimally invasive surgery and colonoscopy. The research is carried out in close co-operation with surgeons and biologists.
Minimally invasive surgery is carried out through very small incisions in the skin to reduce damage to healthy tissues. The incisions, however, hamper the instrument movements, making it difficult to approach organs from different sides. Steerable instruments can solve this problem but are complex and difficult to miniaturize. At TU Delft, a novel steerable mechanism based on tentacles of squid has been developed. The mechanism is very simple and can be easily miniaturized up to very small diameters. The mechanism is patented and being commercialized into a range of steerable instruments for laparoscopy, eye-surgery and catheter interventions.