



**Karolinska  
Institutet**

**The Department of Clinical Neuroscience and Center for  
Hearing and Communication Research**

# **Cochlear Mechanics Unleashed; Design and Application of Superresolution Techniques in the Cochlear Apex**

**AKADEMISK AVHANDLING**

som för avläggande av medicine doktorsexamen vid Karolinska  
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## **Abstract**

**Hearing is one of the five traditional senses. Next to vision it is probably the most important for man and plays a crucial role in day-to-day communication. However, hearing is extremely challenged by modern life style, due to increasing noise exposure and aging societies. Ten percent of the world population is estimated to be hearing impaired. Unfortunately, most conditions cannot be treated sufficiently, a fact often attributed to the very limited understanding of inner ear workings. Early on, it was recognized that the sensitivity of the ear is dramatically enhanced by an active process, termed cochlear amplification, which remains enigmatic.**

**The first part of this thesis presents two complementary optical techniques to measure vibration amplitudes, which are orders of magnitude smaller than the wavelength of light. Both methods are adapted to probe the physiologically relevant low frequency part of the organ of Corti, which is responsible for speech reception. In the second part of the thesis we employ these methods to investigate the role of the large electrochemical potential surrounding the hearing organ. This endogenous extracellular potential is hypothesized to play an important role in cochlear amplification, but its immediate impact on cochlear mechanics is highly speculative. We show that the endocochlear potential leads to sustained deformations of the hearing organ and spatially distinctive alterations of the mechanical response to sound perception.**

**The third part of the thesis investigates the role of membrane cholesterol in somatic hair cell motility, which is one of two mechanisms hypothesized to underlie cochlear amplification. We show that reducing cholesterol dramatically affects the interaction of the hearing organ with the endocochlear potential.**

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