

In vivo imaging and low-coherence interferometry of organ of Corti vibration

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Abstract. An optical coherence tomography (OCT) system is built to acquire in vivo both images and vibration measurements of the organ of Corti of the guinea pig. The organ of Corti is viewed through a $\sim 300\text{-}\mu\text{m}$ -diam hole in the bony wall of the cochlea at the scala tympani of the first cochlear turn. In imaging mode, the image is acquired as reflectance $R(x, z)$. In vibration mode, the basilar membrane (BM) or reticular lamina (RL) are selected by the investigator interactively from the $R(x, z)$ image. Under software control, the system moves the scanning mirrors to bring the sensing volume of the measurement to the desired membrane location. In-vivo images of the organ of Corti are presented, indicating reflectance signals from the BM, RL, tectorial membrane, and Reissner's membrane. The tunnel of Corti and the inner sulcus are also visible in the images. Vibrations of ± 2 and ± 22 nm are recorded in the BM in response to low and high sound levels at 14 kHz above a noise floor of 0.2 nm. © 2007 Society of Photo-Optical Instrumentation Engineers. [DOI: 10.1117/1.2717134]

Keywords: cochlea; vibration; optical coherence tomography; interferometry

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1 Introduction

2 Current research in hearing is concerned with the mechanics
3 of how sound waves propagate down the ribbon-shaped basi-
4 lar membrane (BM), and how movement of the membrane

imparts movement to the cellular and noncellular components⁵
of the organ of Corti, which are attached to the BM. Critical⁶
vibration components are the BM, the hair cells, the reticular⁷
lamina (RL), and the gelatinous tectorial membrane (TM).⁸
The organ of Corti is a complex irregularly shaped structure⁹
that moves in a complex fashion when the BM vibrates, im-¹⁰

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