

A Totally Implantable Hearing Device for Restoration of Hearing

Rong Z. Gan,¹ Chenkai Dai,¹ Don Nakmali,^{1,2} and Mark W. Wood²

¹University of Oklahoma, Norman, OK

²Hough Ear Institute, Oklahoma City, OK USA

Middle ear implantable hearing devices as an emerging and effective technology can offer advantages to the individuals with mild to moderately severe sensorineural hearing loss. Several devices with piezoelectric or electromagnetic transducers have been developed. A totally implantable hearing system (TIHS) consisting of a subcutaneous microphone, sound processor, and electromagnetic transducer has been investigated. The design of the TIHS has incorporated the bioengineering approaches based on a 3D finite element (FE) computational model of the human ear and

the FE analysis of electromagnetic coupling of the transducer. In this paper, we report the technologies developed for the TIHS and experimental measurements in bench setup and human temporal bones with the TIHS prototype. The tests conducted on the device to characterize its performance across the auditory frequency range include: 1) mass loading effect on residual hearing with the passive implant, 2) effectiveness of the electromagnetic coupling between implanted coil and magnet, and 3) function characterization of whole unit in response to acoustic input across the skin. The results indicate that the TIHS prototype tested in human cadaver ears or temporal bones shows satisfactory performance of the system. The data obtained from those preliminary studies will be used for future clinical trials of the TIHS.