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ABSTRACT OF THE MASTER'S THESIS

Author:	Klaus A J Riederer
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Instructor:	Lic. Tech. Jyri Huopaniemi
Supervisor:	Professor Matti Karjalainen

This study familiarizes with the essentials of human spatial hearing and it's engineering methods by the way of head-related transfer functions, i.e., HRTFs. The human auditory system perceives the spatial information of a sound source by detecting interaural time and level differences (ITDs and ILDs), as well as by the spectral cues caused by the human body. The interaction of these matters is denoted as HRTFs that involve measured or modeled responses of a sound source in a free-field space to a point in the ear canal and include all basic binaural spatial information. The numerous applications of the so-called binaural technology leaning on HRTFs vary from human hearing research to sound reproduction of virtual systems, e.g., auditory displays. For most purposes the HRTFs are modeled, i.e., synthesized by digital filters.

The current work depicts in fine detail a devised high-quality automated HRTF measurement system and the applied measuring procedure. Blocked ear canal measurements were performed in an anechoic chamber for 66 subjects, employing 252 directions of sound incidence and a constant distance of 1.9 m. Also, a near-field scrutiny for the horizontal plane was practiced for a sound source distance of 0.7 m. The test subject was accurately positioned to a special measurement chair and miniature microphones were attached to the entrance of the blocked ear canals. The whole measurement procedure was controlled by a computer, which also generated the stimulus, i.e., a pseudorandom flat spectrum random phase sequence.

A comprehensive analysis of the obtained, well-repeatable, results is also given and compared to the mathematical models and theories of spatial hearing presented in the beginning of the work. The largest variance between persons, especially above 6..7 kHz, is found in the directions where the sound source is located towards the opposite ear. The direction-dependency of the HRTFs is noted as intense resonance structures above 1..2 kHz. At lower frequencies the human body does not affect the sound field. The ILD grows as the distance of the sound source declines. After the cropping of the knee and turntable reflections, the measurements are in an excellent visual agreement to the ones in a very good reference research published in literature.

Keywords: acoustic and audio measurement, auralization, binaural technology, digital signal processing, head-related transfer function, spatial hearing, 3-D sound