Experimental and Analytical Study Approach of Artificial Basilar Membrane Prototype (ABMP)

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Abstract. In this research, we have developed, fabricated, tested, and analyzed an artificial basilar membrane prototype (ABMP), which works using simsoidal waves of various frequencies. The design of the prototype has a trapezoidal shape with a length of 30 mm and a width of 2 to 4 mm. The research was carried out experimentally and analytically. Experimentally, the ABMP's vibration was measured using a laser Doppler vibrometer (LDV) and a function generator to generate various frequencies. The analytical approach is discussed based on the Wentzel Kramer Brillouin method (WKB). The results show that resonance frequencies can be reached within the range of human hearing, between 20 Hz to 20 kHz.

Keywords: *ABMP; cochlea; frequency; frequency selectivity; PVDF; resonance; vibrating amplitude; WKB.*

1 Introduction

The ears are a component of the human auditory system. Hearing impairment can be brought about by many causes. Sensorineural hearing loss is one of them. Usually, in medicine a cochlear implant (CI) or hearing aid (HA) is used to assist the patient who suffers from deafness. In this paper, we discuss an artificial basilar membrane prototype (ABMP) using a piezoelectric membrane made of polyvinylidene fluoride (PVDF). The function of the cochlea in the human auditory system is not only to convert acoustic sound to electrical signals but also frequency selectivity. The biological basilar membrane, which is a resonator in the cochlea, plays a prominent role infrequency selectivity. In this experiment, we report the development of a fully self-contained artificial cochlea, the aforementioned ABMP. The acoustic sensor which is reported in this paper realizes frequency selectivity in the air. Normal humans can hear sounds in the frequency range of 20 Hz to 20 kHz.

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