

Design and Implementation of Multichannel Piezoelectric Acoustic Sensor

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Introduction:

This work concentrates on developing a self-contained cochlea whose performance is at par with natural hearing.

- The Artificial Basilar Membrane (ABM) design is done in such a manner so as to get a performance similar to the natural hearing.

Figures for basic model for cochlear implant and placement of electrodes.

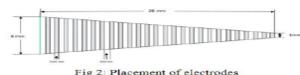


Figure 1 and 2. Basic Model for cochlear Implant and Placement of electrodes

Design Equations for computing number of electrodes :

$$N=L/(D+L_1) \quad (i)$$

$$N=28\text{mm}/(700\mu\text{m}+500\mu\text{m}) \quad (ii)$$

$$= 23.33$$

Where ,

L= Length of ABM

L₁= Length of each electrode

D= Distance between two electrode

W=Width of the electrode

N= Number of electrode

T= Thickness of ABM

T₁= Thickness of each electrode.

Also following assumptions are made,

L= 28mm

D= 700um

L₁= 500um

Results:

Use of COMSOL Multiphysics to generate ABM model.



Figure 3. Use of COMSOL to generate ABM model



Figure 4. Displacement versus frequency at 3000Hz

Table 1: Relative error for various frequencies

Frequency in Hz	Displacement in mm Theoretical results	Displacement in mm Simulated results	Relative error in %
2000	11.968	11.50	+4.0706
3000	16.2656	16.80	-3.18045
4000	19.5745	20.40	-4.04649

Table 1. Relative error for different frequencies

Table 2:Comparative Analysis of performance of PVDF and PZT

Frequency (KHz)	Distance from Apex in mm		
	Natural Basilar Membrane	PVDF	PZT
1	18.1284	23.5	23.38
2	12.804	18.23	23.27
3	9.962	11.97	21.13
4	8.1408	9.87	17.69
5	6.7952	7.7	16.64
6	5.728	8.1	14.56

Figure 5.Comparative Analysis of performance of PVDF and PZT

Conclusions: Tables 1 and 2 gives us assessment of the performance of the two materials and it can be concluded that PVDF is better material to be uses in ABM construction compared to PZT 5A and as frequency increases the maximum displacement at the point of resonance shifts from apex to base of ABM. Relative error between theoretical and the simulation results varies between +/-5% approximately.

References:

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