The Dynamics of Language

David Dalrymple and Yiren Lu

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Abstract

This paper models the human cochlea as a coupled series of damped mass-spring oscillators, then performs analysis on its parameters, including the frequency of incoming sounds and the stiffness of the basilar membrane. Particularly, this paper will focus on the human cochlea's critical oscillations, which provide its remarkable amplifying propreerties. The critical oscillations are a result of the cochlea's

1 Introduction

The cochlea is a small spiral-shaped, fluid-filled cavity in the human ear. It is responsible for the transmission of pressure from the middle ear, and for the translation of these pressure impulses into electrical impulses subsequently carried by neurotransmitters to the brain. Computational simulations of the cochlea are motivated by a desire to understand how it is that we are able to hear, and by extension, how we are able to process language.

However, due to the geometric complexity and small size of the cochlea, it can often be difficult to model. This paper presents a

structure of outer hair cells on the basilar membrane is tuned to be a linear array of coupled cells, each tuned near a hopf bifurcation point but at different frequencies

Outline The remainder of this article is organized as follows. Section 2 gives account of previous work. Section 3 provides the mathematical equations behind the modeling of the cochlea. The computational framework of our simulation, coded in C, will be outlined and explained in Section 4. Our results, mostly about effects of changing the parameter space, are described in Section 5. Finally, Section 6 gives the conclusions.

2 Previous work

The cochlea has been studied extensively.

3 Mathematical Basis for Modeling

It's not entirely clear what the P_n term should be, but the rest of the system looks something like this: $\ddot{x}_i = -\frac{1}{m_i}\left(k_i x_i + c_i(x_i - x_{i-1}) + b_i \dot{x}_i\right)$ With $v_i = \dot{x}_i$, this translates into two equations for a dynamical system: $\dot{v}_i = -\frac{1}{m_i}\left(k_i x_i + c_i(x_i - x_{i-1}) + b_i v_i\right)$
$\dot{x}_i = v_i$ Of course, the actual dynamical system would have $2n$ equations, depending on the number of oscillators included.

4 Computer Simulation

5 Results

In this section we describe the results.

6 Conclusions

We worked hard, and achieved very little.

References