The Representation of Speech in a Biophysically Detailed Model of the Ventral Cochlear Nucleus
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I. INTRODUCTION

The cochlear nucleus (CN) is the first stage where auditory information enters the brain. Auditory nerve fibers project to the different areas of the cochlear nucleus such that the tonotopic organization is preserved (Fig. 1).

II. MODEL STRUCTURE AND COMPUTATIONAL IMPLEMENTATION

The phemomenological A11 model of Bruce et al. (2018) provides inputs to the VCN cell models. Rothman and Mans (2002) type VCN cell models are used in this first stage of model mechanisms. The expoun function created for this research is based on Carnewe and Hovea (1993) expoun function from NEURON. Cell connections are modeled as simple exponential decay with time constant of 2.5 msec for excitatory connections and double exponential function with time constant of 0.2 msec and 2.5 msec for inhibitory connections.

II. RESULTS

Figure 2: Bruce et al. (2018) auditory pathway model. Panels D and C compare the old and new model with the new one. The new model updated synaptic and spike generation. Appetite: onset, fade out and single (OFC), intrinsic cell (IC), Purkinje (P), edge, reticular thalamic nucleus (RTN), inner hair cell (IHC), low-pass (LP) filter, static nonlinearity (NL), static nonlinearity (NL), static nonlinearity (NL), static nonlinearity (NL), static nonlinearity (NL), static nonlinearity (NL).

Figure 3: Comparison of current injection simulation results with cell model results presented in Blackburn and Sachs (1990). Figure 4: Comparison of current injection simulation results with cell model results presented in Blackburn and Sachs (1990). Figure 4: Comparison of current injection simulation results with cell model results presented in Blackburn and Sachs (1990). Figure 5: Frequency spectrum representation of sound... 

REFERENCES

Manis and Campagnola (2018) tested their new model through the same general procedures as Rothman and Mans (2003). However, only a subset of simulation results were presented in Manis and Campagnola (2018), and they did not perform an extensive testing of the strength of inhibitory inputs in their model. Therefore the results obtained in this study could not be compared directly with simulation results from other research. However, by testing physiological data and Rothman and Mans (2003) cell model responses in the updated Manis and Campagnola (2018) cell models developed in this study, we have seen how close re semblance to the real word data. Inhibitory effects on firing behavior of cells were investigated by creating a bushy cell model. In these simulations, inhibitory inputs from DS to TV were added to the model. The results show that inhibitory inputs have a large effect in regulating the firing behavior of the main cell types of the VCN. At the inhibitory inputs become stronger, the tuning of bushy cells is reduced. The inhibitory input from DS to TV is almost entirely of primary-like, chopper and pauser neurons.

III. CONCLUSIONS

Manis and Campagnola (2018) tested their new model through the same general procedures as Rothman and Mans (2003). However, only a subset of simulation results were presented in Manis and Campagnola (2018), and they did not perform an extensive testing of the strength of inhibitory inputs in their model. Therefore the results obtained in this study could not be compared directly with simulation results from other research. However, by testing physiological data and Rothman and Mans (2003) cell model responses in the updated Manis and Campagnola (2018) cell models developed in this study, we have seen how close re semblance to the real word data. Inhibitory effects on firing behavior of cells were investigated by creating a bushy cell model. In these simulations, inhibitory inputs from DS to TV were added to the model. The results show that inhibitory inputs have a large effect in regulating the firing behavior of the main cell types of the VCN. At the inhibitory inputs become stronger, the tuning of bushy cells is reduced. The inhibitory input from DS to TV is almost entirely of primary-like, chopper and pauser neurons.