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Alessandro Altoè, Ville Pulkki, Sarah Verhulst

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# The effects of the activation of the inner-hair-cell basolateral $K^+$ channels on auditory nerve responses

Alessandro Altoè<sup>1a</sup>, Ville Pulkki<sup>a</sup>, Sarah Verhulst<sup>b</sup>

<sup>a</sup>*Department of Signal Processing and Acoustics, School of Electrical Engineering, Aalto University, P.O. Box 13000, FI-00076 Aalto, Finland*

<sup>b</sup>*Department of Information Technology, Technologiepark 15, 9052 Zwijnaarde, Belgium*

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## Abstract

The basolateral membrane of the mammalian inner hair cell (IHC) expresses large voltage and  $Ca^{2+}$  gated outward  $K^+$  currents. To quantify how the voltage-dependent activation of the  $K^+$  channels affects the functionality of the auditory nerve innervating the IHC, this study adopts a model of mechanical-to-neural transduction in which the basolateral  $K^+$  conductances of the IHC can be made voltage-dependent or not. The model shows that the voltage-dependent activation of the  $K^+$  channels (i) enhances the phase-locking properties of the auditory fiber (AF) responses; (ii) enables the auditory nerve to encode a large dynamic range of sound levels; (iii) enables the AF responses to synchronize precisely with the envelope of amplitude modulated stimuli; and (iv), is responsible for the steep offset responses of the AFs. These results suggest that the basolateral  $K^+$  channels play a major role in determining the well-known response properties of the AFs and challenge the classical view that describes the IHC membrane as an electrical low-pass filter. In contrast to previous models of the IHC-AF complex, this study ascribes many of the

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<sup>1</sup>corresponding author, [alessandro.altoe@aalto.fi](mailto:alessandro.altoe@aalto.fi)

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