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A computational model of the mammalian brainstem to solve sound localization

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Implementing bioinspired neural networks *in silico* is a powerful tool for studying brain processes. These networks grant access to the real-time behavior of individual neurons within a complex circuitry, such as the ones executing neurosensory functions.

This contriubtion proposes a computational model to study how the mammalian brainstem implements sound localization: the ability to identify an acoustic source in the surrounding space. The main actors in sound localization are two brainstem nuclei: the medial and the lateral superior olive. We have reconstructed a model made of thousands of spiking neurons tailored to the auditory brainstem circuitry and its tonotopic organization.

The major inputs of our model are two acoustic information intrinsically linked to the position of a sound source in space, the interaural time difference (ITD) and level difference (ILD). Respectively, they consist of the disparity in the arrival time and in the intensity of sound between the right and the left ear.

With such a realistic model, we tested the latest neuroscience theories on how these two brainstem nuclei exploit these binaural cues to create an auditory map in the brain.
Eventually, we shed light on the dual pathway that, thanks to its redundancy, improves the precision and reliability of sound source identification.

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Topic area

models and applications

Keywords

spiking neural network, computational model, neurosensory systems, spatial hearing, sound localization, MSO, LSO, brainstem, binaural cues, ITD, ILD

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Talk (& optional poster)

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