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Auditory models and nonlinear filterbanks in underwater auralization

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Mammals like dolphins and humans have the ability to distinguish between different objects by listening to their scattered signals. We explore this phenomenon by evaluating the "Auditory Image Model" (AIM), a biologically inspired model of the human auditory system from the outer ear up to central processing. AIM aims to simulate the spectral analysis of the basilar membrane, the neural encoding and the temporal integration performed by the auditory system. Simulated scattered signals from the same object objects of different sizes and different objects of same size subjected to an incident pulse were analysed numerically with AIM, simulating the response of the human auditory system. The resulting neuronal activity patterns were analysed in two independent dimensions using the filter centre frequency and the relative timing intervals of the responses. The results are interpreted globally as reflecting the size and the shape/properties of the object respectively. We show for a series of calibration stimuli that the model can distinguish between same objects of different size and different objects of the same size. We also discuss how a nonlinear model of the basilar membrane, performing a Gammachirp/Mellin transformation, may act as a possible feature extraction tool for classification methods