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An autocorrelation model of bat sonar

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Their sonar system allows echolocating bats to navigate with high skill through a complex, three-dimensional environment at high speed and low light. The auditory analysis of the echoes of their ultrasonic sounds requires a detailed comparison of the emission and echoes. Here an auditory model of bat sonar is introduced and evaluated against a set of psychophysical phantom-target, echo-acoustic experiments. The model consists of a relatively detailed simulation of auditory peripheral processing in the bat, Phyllostomus discolor, followed by a functional module consisting of a strobed, normalised, autocorrelation in each frequency channel. The model output is accumulated in a sonar image buffer. The model evaluation is based on the comparison of the image-buffer contents generated in individually simulated psychophysical trials. The model provides reasonably good predictions for both temporal and spectral behavioural sonar processing in terms of sonar delay-, roughness, and phase sensitivity and in terms of sensitivity to the temporal separations in two-front targets and the classification of spectrally divergent phantom targets.