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**A modeling approach to explain pulse design in bats.** (English) Zbl 1125.92064  
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Summary: In this modeling study we wanted to find out why bats of the family Vespertilionidae (and probably also members of other families of bats) use pulses with a certain bandwidth and duration. Previous studies have only speculated on the function of bandwidth and pulse duration in bat echolocation or addressed this problem by assuming that bats optimize echolocation parameters to achieve very fine acuities in receiving single echoes. Here, we take a different approach by assuming that bats in nature rarely receive single echoes from each pulse emission, but rather many highly overlapping echoes. Some echolocation tasks require individual echoes to be separated to reconstruct reflection points in space. We used an established hearing model to investigate how the parameters bandwidth and pulse duration influence the separation of overlapping echoes. Our findings corroborate the following previously unknown or unsubstantiated facts:

(1) Broadening the bandwidth improves the bat's lower resolution limit. (2) Increasing the sweep rate (defined by bandwidth and pulse duration) improves acuity of each extracted echo. (3) Decreasing the sweep rate improves the probability of frequency channels being activated.

Since facts 2 and 3 affect sweep rate in an opposing fashion, an optimum sweep rate will exist, depending on the quality of the returning echoes and the requirements of the bat to improve acuity. The existence of an optimal sweep rate explains why bats are likely to use certain combinations of bandwidth and pulse duration to obtain such sweep rates.

**MSC:**

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