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Neural adaptation and the recovery function: Some insights from a simple mathematical model

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A greater knowledge of the temporal aspects of the response of the auditory nerve to electrical stimulation is important for understanding how signal processing strategies could be improved in transmitting sound information to the cochlear implant. Neural adaptation measures using NRT demonstrate how the compound action potential eventually settles down over time to a lower constant value (Dillier et al, 2005). Furthermore, the response amplitudes initially had an oscillatory character which then eventually changed to a stochastic one.

Methods
The primary candidate for explaining the adaptation is the recovery function. A first order model of neural adaptation based on the recovery function alone was then constructed and tested.

Results
The model successfully reproduced the reduction in the response amplitude, but the oscillatory character of the response amplitudes could not be reproduced.
When constructing the model, a number of assumptions and simplifications had to be made. One such assumption was that the recovery function time constant would always be the same. The basic premise of basing the model on the recovery function was probably justified. However, other assumptions such as the invariability of the recovery function time constant was probably incorrect.
Subsequent recovery function measurements with different numbers (1 to 5) of preceding maskers showed that the time constant was not always the same.

Conclusion
A better understanding of the way the recovery function's time constant changes with preceding stimulation needs to be accounted for when developing models of the auditory nerve.

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Literatur:
Dillier N, Lai WK, Battmer RD, Pesch J, Killian M (2005). Measurements of neural adaptation effects dependent on rate of stimulation, Poster presented at Conference on Implantable Auditory Prostheses, Asilomar.