Sonderforschungsbereich/Transregio 31
“Das aktive Gehör”

# E I N L A D U N G

zum Vortrag im Rahmen des Seminars des SFB/TRR 31

## Freitag, 13. Januar 2017, 11.00 Uhr c.t.

im Raum H28 / R 2.31 des Med. Campus Magdeburg und
Raum W30 0-33/34 der Universität Oldenburg (NeSSy) (per Videoübertragung)

## *"Modeling electrical stimulation of the auditory nerve considering two sites of spike generation"*


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Cochlear implants (CIs) enable severely hearing impaired or deaf listeners to perceive sounds. The speech intelligibility performance of CI listeners in quiet is a convincing argument for the success of these devices. However, despite large efforts in the development of signal processing- and stimulation strategies, no larger improvements in aspects like spatial hearing, pitch perception and speech intelligibility in background noise have been achieved during the last years. CI stimulation strategies mainly extract the slowly varying envelope of the sounds and stimulate the auditory nerve (AN) with trains of biphasic pulses, modulated with the extracted envelope. Several stimulation strategies aimed to improve the envelope coding in the electrically stimulated AN fibers (ANFs) have failed to provide the anticipated benefits. This indicates a lack of understanding the temporal response properties of the electrically stimulated ANF. Several models of the electrically stimulated ANF have been proposed, none of which so far could account for temporal response statistics found in the electrically stimulated ANF of animal models.

This presentation introduces a novel phenomenological model of the electrically stimulated AN based on two exponential integrate-and-fire neurons with adaptive feedback loops, modeling the peripheral and the central axons of the ANF. The model can account for the main aspects of temporal response statistics of ANF firing patterns evoked by monophasic pulses of both, anodic and cathotic polarity. With the same parameter set, the model generalizes to biphasic pulses, paired pulses, various pulse shapes and pulse trains showing sub- and suprathreshold adaptation effects like accomodation and facilitation.

In combination with a neurometric analysis, the model was successfully used to account for behavioural data of human CI users on modulation detection thresholds for various stimulation parameters like pulse shape, level and pulse rate. Duplication of the model to binaural channels allowed to account for the effects of pulse jitter, pulse rate and modulation frequency on ITD-JNDs in CI listeners.It will be shown that the uncertainty of the site of spike generation accounts for some of the observed effects, and that the interaction between spikes evoked at the peripheral and the central axons is crucial to account for the data. Several perspectives of the model will be discussed to with the goal to provide an objective tool to predict and to improve the performance of CI listeners in aspects related to temporal processing like spatial hearing and pitch-related tasks.