

A NEW RESEARCH IMPLEMENTATION OF MP3⁰⁰⁰™ TO IMPROVE INTERMEDIATE PITCH PERCEPT BETWEEN ELECTRODE CONTACTS

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Abstract

A new research implementation of MP3⁰⁰⁰™ to improve intermediate pitch percept between electrode contacts has been developed. Several pitch ranking, melody recognition and speech understanding tests were conducted in order to identify the benefit of this research implementation named V-PACE. No significant benefit could be found for speech understanding and melody recognition. Pitch ranking was identified to be significantly better with V-PACE without influencing the speech understanding.

Background

MP3⁰⁰⁰™ is the first commercial signal processing strategy for cochlear implants making use of a psychoacoustic masking model derived from normal hearing listeners. It reduces the number of electric stimuli inside the cochlea thus lowering channel interaction and power consumption without compromising speech understanding [1]. However, due to the intrinsic behaviour of psychoacoustic masking models, stimuli generated by MP3⁰⁰⁰™ are relatively isolated compared to stimulation patterns created by the ACE strategy. Therefore the perception of virtual channels may be reduced when using MP3⁰⁰⁰™. To avoid this problem, a research variant of MP3⁰⁰⁰™ named V-PACE is currently under investigation. This strategy still uses the psychoacoustic masking model, but instead of selecting isolated channels, pairs of neighbouring channels are always being selected, such that the principle of intermediate pitch percept between physical electrode contacts should be maintained.

Material and methods

Nine subjects (4 males, 5 females) were recruited for the study. All subjects are actively using a Nucleus® Freedom™ sound processor with ACE (N=5) or MP3⁰⁰⁰™ (N=4) strategy for at least 6 months and have experience with a cochlear implant system for at least 12 months. The mean age of this group was 53.8 years (range 23–73 years). The subjects were evaluated with an ABCCBA cross-over design. A single-blind investigation was used.

The three conditions are:

- MP3⁰⁰⁰™ Strategy (5 Maxima).
- V-PACE Strategy (5 Maxima, max. 10 Electrodes) Stimulation Rate / Electrode similar to MP3⁰⁰⁰™.
- V-PACE ½ Strategy (5 Maxima, max. 10 Electrodes) Stimulation Rate / Electrode 50% of MP3⁰⁰⁰™.

Besides speech perception tests in noise and pitch discrimination, also melody recognition skills have been used to evaluate the different conditions. The assessment of the melody recognition skills was conducted by the Modified Melodies Software [2].

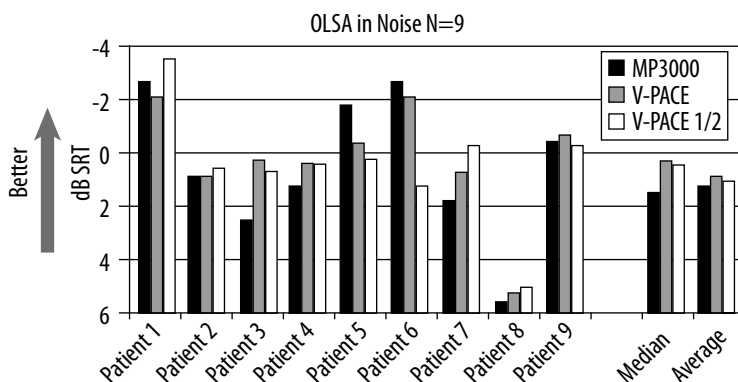


Figure 1. Speech performance results.

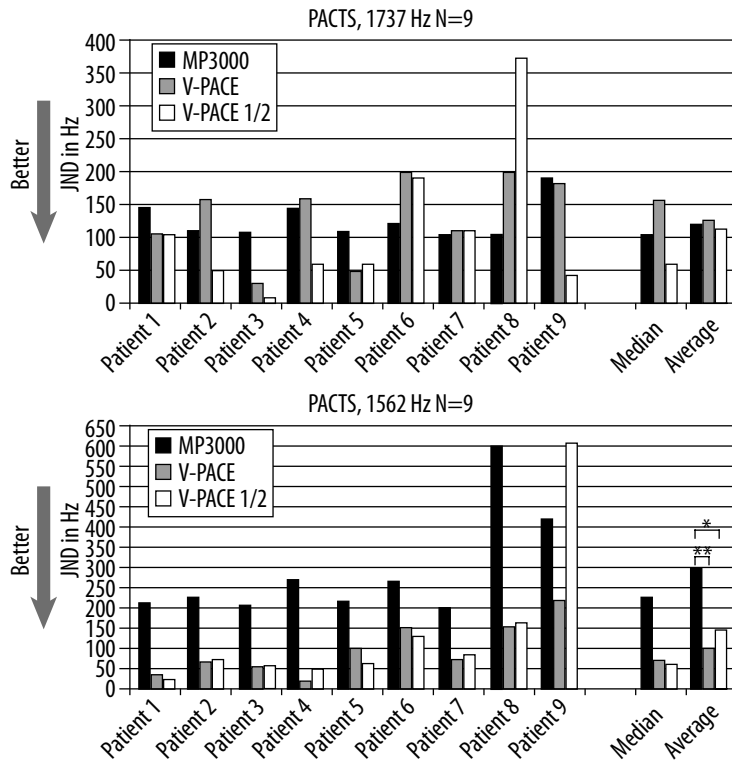


Figure 2. Pitch ranking results.

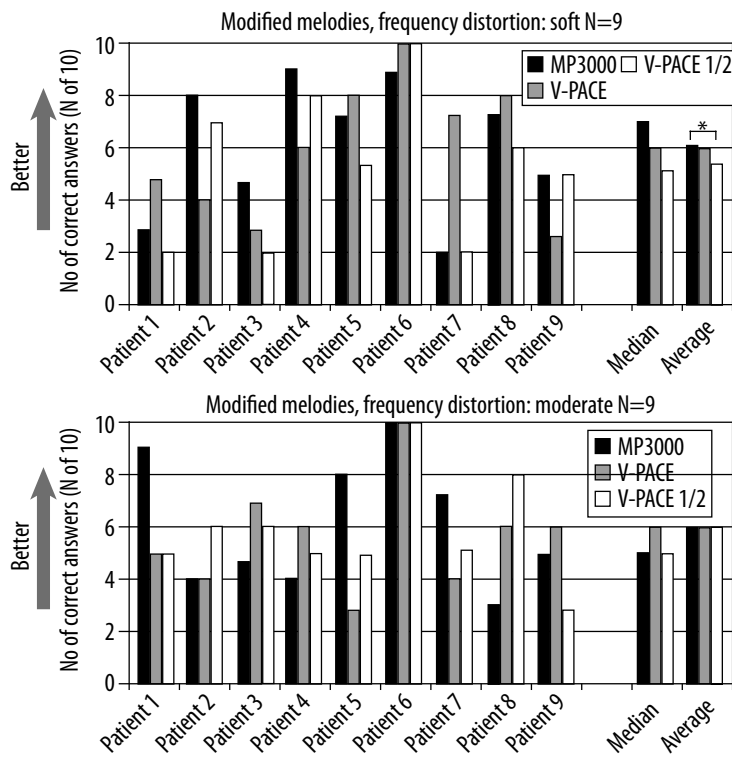


Figure 3. Melody recognition results.

Results

Figure 1 shows the SRT in dB for the standardised adaptive OLSA test in fixed background noise at 65 dB.

Figure 2 shows the JND for the 3 AFC test via direct coupling. 1437 Hz indicates the mid-band frequency and 1562 Hz indicates the cut-off-band frequency.

Figure 3 shows the % correct for the identification of the correct melody. Frequency Distortion „soft“ indicates the more difficult condition and „moderate“ the easier condition.

Discussion

Even there was a subjective preference towards V-PACE in some subjects, no significant improvement of speech performance and pitch discrimination over MP3^{000™} could be found with V-PACE. The single case melody recognition showed clear difference in some subjects, but the average

results show a clear difference for the more difficult condition only. In some pitch discrimination measurements, a significantly better frequency resolution could be found for V-PACE. This does not seem to have an influence to the speech discrimination.

Conclusions

Some pitch ranking tasks showed a significant improvement with V-PACE and should be used as motivation to further investigate in the development of this new research implementation of MP3^{000™}.

References:

1. Buechner A et al: Clinical evaluation of cochlear implant sound coding taking into account conjectural masking functions, MP3000™. Cochlear Implants International, 2011
2. Swanson B: Modified Melodies [computer software]. Sydney: © Cochlear Ltd., 2009