ACOUSTICS2008/1472
Parameters affecting the precedence-effect with cochlear implants

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Monaural spectral and temporal cues as well as binaural cues provide the information to analyze the auditory scene. Subjects using bilateral cochlear implants (CIs) have limited access to those cues, particularly to interaural time differences (ITDs) and to spectral information. Nevertheless, many subjects can localize sounds in quiet based on the evaluation of interaural level differences (ILDs) but this might be impaired by the presence of reflections. We studied the precedence effect with patients wearing bilateral CIs and found that localization was abolished in most subjects when the echo was present, but some subjects showed dominance of the leading sound on localization. The reasons for the different outcomes were studied with simulations of CIs. Using a noise-band vocoder simulation, subjects could not fuse lead and lag into a single object and they localized both separately. With a sinusoidal vocoder, lead-lag fusion and the precedence effect could be obtained provided that frequencies of the carrier sinusoids were matched across ears. Interaural phase of the carrier played only a limited role. We conclude that precedence of ongoing sounds can solely be based on ILDs and envelope-ITDs and that proper place matching of CI-electrodes would help the analysis of concurrent sounds.