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FD-spectrums and their simulation by neural networks

F - AI,connectionist,networks

Introduction

The research reported here is directed at the elaboration of an efficient system for the classification and identification of acoustical signals. In this context,a new frequency representation of acoustical signatures has been developed which is invariant under fade out of frequency bands or under masking of single signature shares. This "metaform" of the signatures results from the projection of all frequencies that are parts of the single oscillations on their fundamental frequencies.

The spectral presentation in which one can find the metaforms is called FD-spectrum and can be generated by rather simple neural networks. Preliminary experiments with these networks suggest that neural modules are of central importance for the computation of these spectrums. This led to the assumption that specific neural substructures rather than single neurons are the fundamental components of an efficient network in pattern recognition.

The modification of the operators that generate socalled eFD- and mFD-spectrums allow the construction of frequency filters and of higher order presentations which can be chosen to select individual qualities for the classification and identification of acoustical sources.

Theoretical frame

We assume that a situation- and problemoriented presentation of acoustical signatures is a necessary processing stage for a classoriented recognition system, which is independent of the acoustical background. The problemoriented presentation is termed 'metaform' of the signature, because it depends only on the situation-independent information of the noise source.

The metaform of the signature will be elaborated by an invariant, domain-independent neural network, whereby the problem is represented in the structure of the network .

The desired feature-specific presentation of acoustical signatures should provide a correct classification and identification of the sound sources even if superposition-effects, scattering of frequencies or from frequencybands (telephon-effect) exist.

As all those effects can be conceived of as a kind of scattering it is just necessary to find a presentation where parts of the signature-frequency-spectrum are redundant. This will be the case if there exists a well-defined point on which all the parts of the signature of one oscillation can be duplicated. As the signature of an oscillation is composed of the fundamental oscillation frequency value and its harmonics, each of these frequency values can be the "representation-point". As all frequency-values can be represented by a frequency-distance one can scan the