Speech Enhancement of Single-Source Audio Signal Using Covariance Matrix Adaptation Evolution Strategy

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**ABSTRACT**

A Covariance Matrix Adaptation Evolution Strategy (CMA-ES) is a method for efficiently searching through a landscape of multiple real-valued parameters to determine which parameter values give the best solution to a known problem. This paper explores the application of CMA-ES to the problem of speech enhancement, that is, recovering the speech signal from a single microphone signal composed of speech and an unwanted background noise. This research makes use of some of the most popular techniques for speech enhancement, and seeks to find an optimal way to combine these techniques to best recover the original clean speech signal. The results show that the combination of these methods, with parameters tuned using CMA-ES, can outperform the component methods individually, with parameters tuned by experts as would commonly be done.

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# INTRODUCTION

The field of speech enhancement aims to apply transformations to a digital signal containing both spoken words as well as some type of unwanted noise, and recover the “clean” version of the signal containing speech alone. This is generally done to improve the intelligibility of the speech, either to be listened to by a human, or processed by a voice recognition system.

As mobile and hands-free technology progresses, cell phones are processing voice input not only for phone calls, but as an interface to many other device features. Voice commands are especially likely to be used while the user is driving a car, when it is often unsafe or illegal to use the traditional interface. For this reason a clip of speech corrupted by road noise was used for this research.

In order to produce the cleanest possible speech signal, 3 common methods of speech enhancements are combined using parameters determined using CMA-ES. These methods are Wiener Filtering, Spectral Subtraction, and Noise Gating, which have a combined total of 8 parameters to be tuned by the evolutionary strategy.

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# Experimental Setup

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