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Reducing Periodic Signals in Biomedical Applications

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Subject area	Digital Signal Processing
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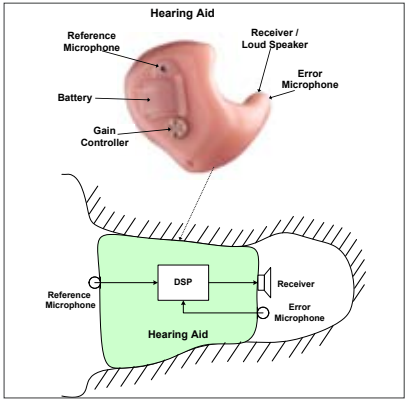
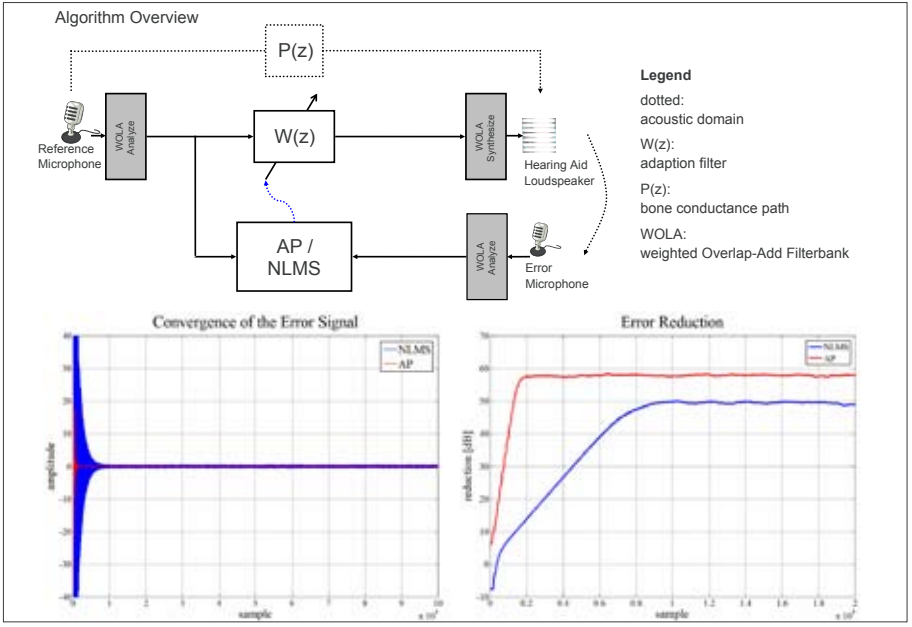


Introduction: Many people need a hearing aid when they get older. People with a congenital hearing defect use hearing aids as well. The hearing aid is a very complex system. First, it must be very small; second, it should not use a lot of power and has to work in many situations.
There are still many challenges for hearing aid design. One of them is the occlusion effect. If you are using a finger to block your ear canal and speak, you can hear a hollow sound from your own voice. This is called the occlusion effect. When you wear a hearing aid you may observe the same effect.

The aim of this diploma thesis is it to tackle this problem using a DSP algorithm.

Procedure: First, the algorithms were implemented in MATLAB to test a couple of different solutions. Second, the best solution was implemented into the firmware. Third, the firmware was tested in the lab and in the real-world environment. Finally, the firmware was modified based on the experimental results in order to improve it.

Principles: One way to reduce the occlusion effect is to generate a signal that cancels or reduces



the own speech signal in the canal. Specifically, the LTI System P in the figure can be estimated with a FIR filter. Two different algorithms were used to estimate the system P. The figure shows the implemented structure of the NLMS (Normalized Least Mean Square) algorithm and the AP (Affine Projection) algorithm.

The AP algorithm strikes a good tradeoff between a fast convergence speed as in the RLS algorithm and a reasonable computational cost as in the LMS algorithm. The figure shows the different convergence speeds and the error signals.

Conclusion: The simulation results showed that the AP algorithm is the best algorithm to reduce the occlusion effect. This algorithm converged faster and had greater error reduction compared with the NLMS algorithm. The real-world environment results will be obtained, analyzed and presented at the end of this project.