Silesian University of Technology

Faculty of Automatic Control, Electronics and Computer Science

Applications of Control Systems

Active Noise Cancellation

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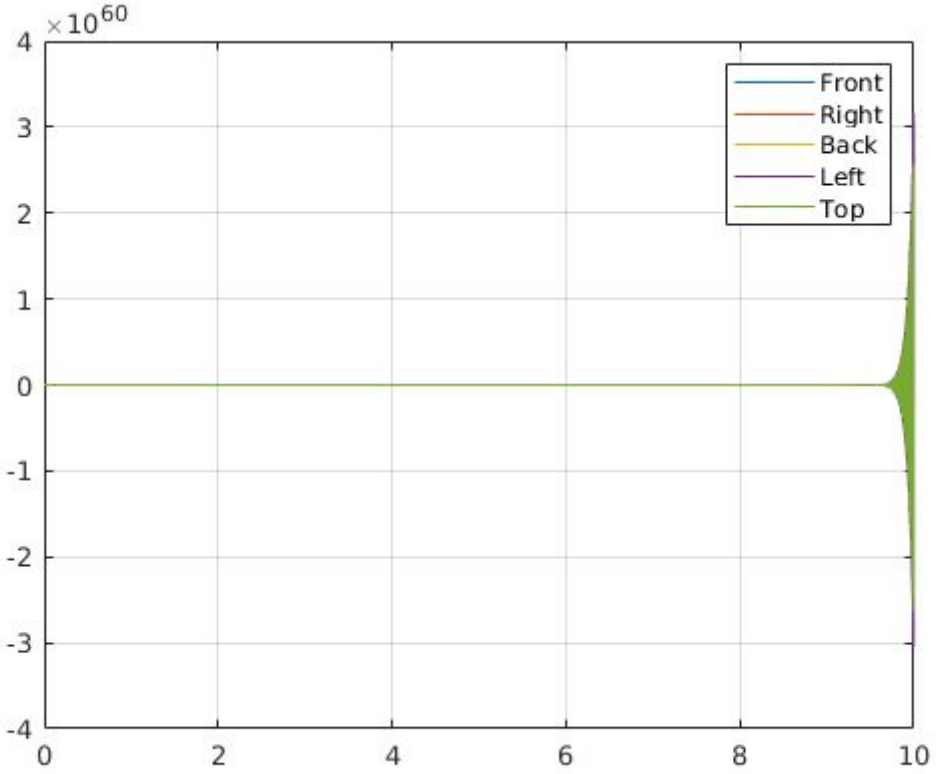
1. Introduction

The aim of the block of two classes was to familiarize with the topic of active noise cancelling (ANC). During the exercises it was necessary to create a program simulating active noise reduction based on samples collected from a real object located in one of the laboratory rooms which is casing with casing device with 21 actuators connected to the walls, noise source as a speaker inside of casing, reference microphone inside casing measuring noise signal and 5 error microphones located each side outside of the box. The simulation is based on models as 128-length FIR filters and algorithm used is Leaky FxLMS (or normal FxLMS) with filter length 128.

2. Final effect in chart

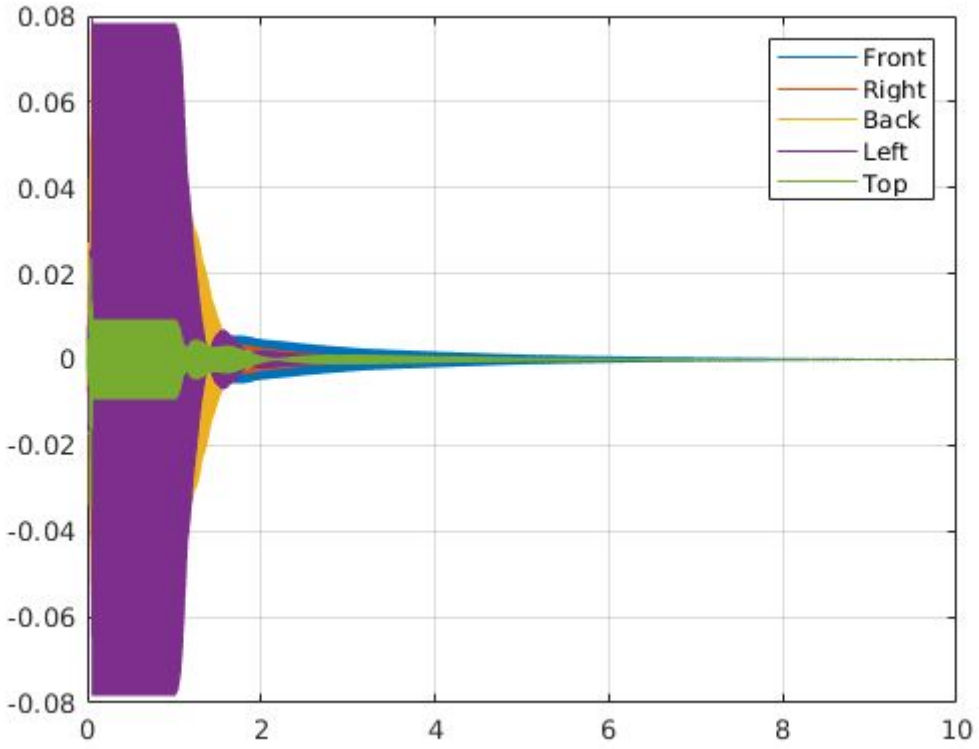
We simulated different noise sources for checking how this algorithm works and how fast it converges for different mu parameters. At first we checked convergence to tune mu parameter based on single-tone sine signal as a noise source.

mu = 1000:

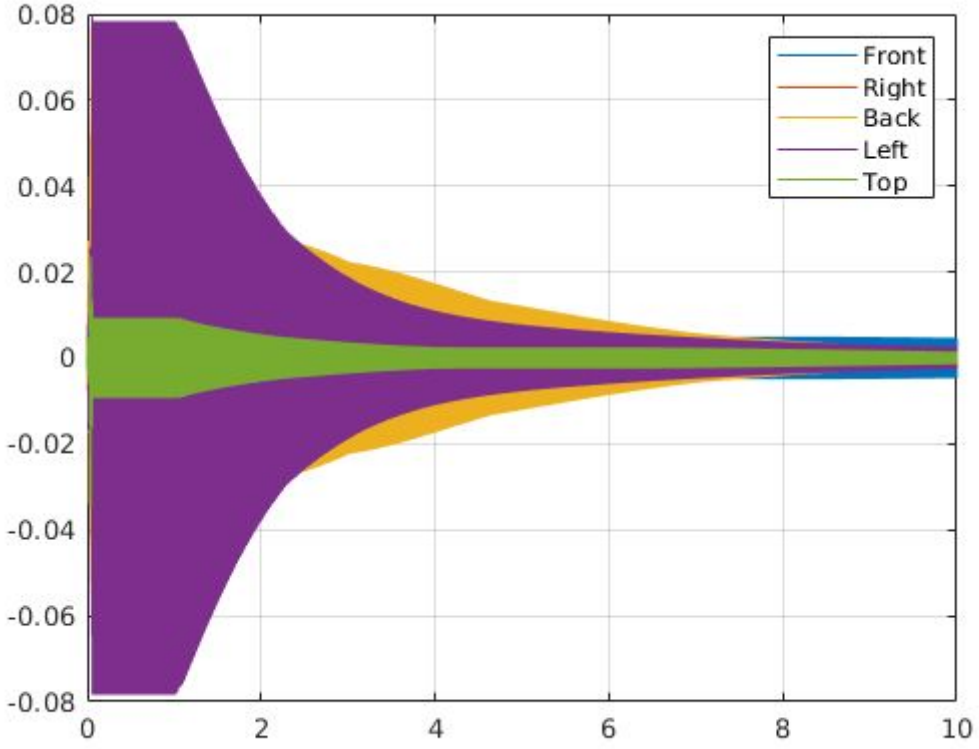


This algorithm is unstable so the mu parameter is too high.

mu = 100:


0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
0
2
4
6
8
10
Front
Right
Back
Left
Top

mu = 10:


0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
0
2
4
6
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10
Front
Right
Back
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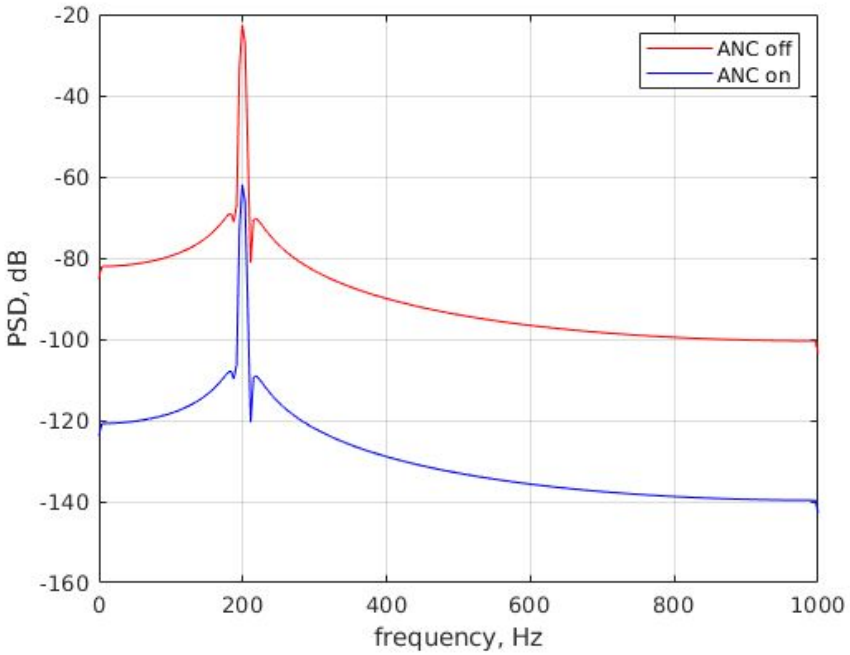
Top

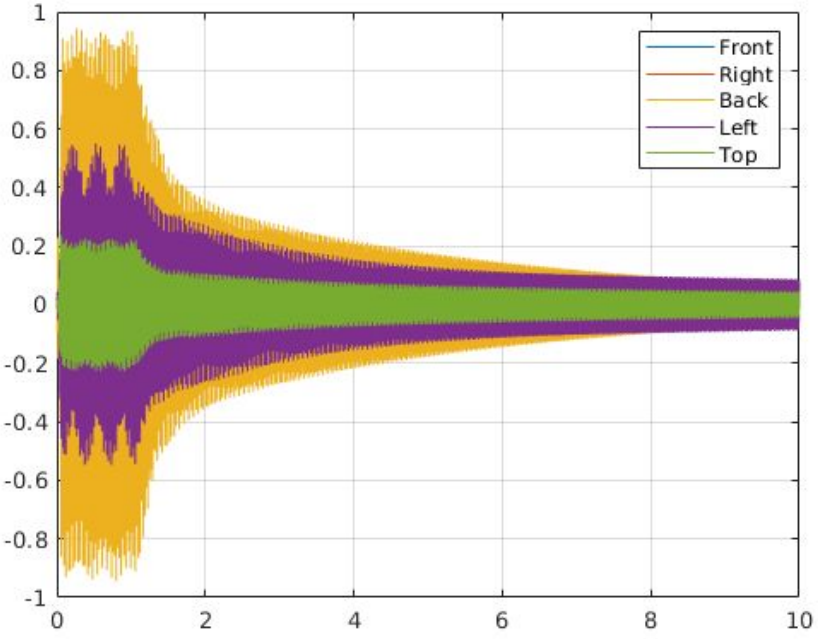
We can observe that with mu = 100 algorithm is stable and converges quite quickly, way faster than with mu = 10, but this may result in higher noise level at the steady state of algorithm.

We decided to base other tests on mu = 100.

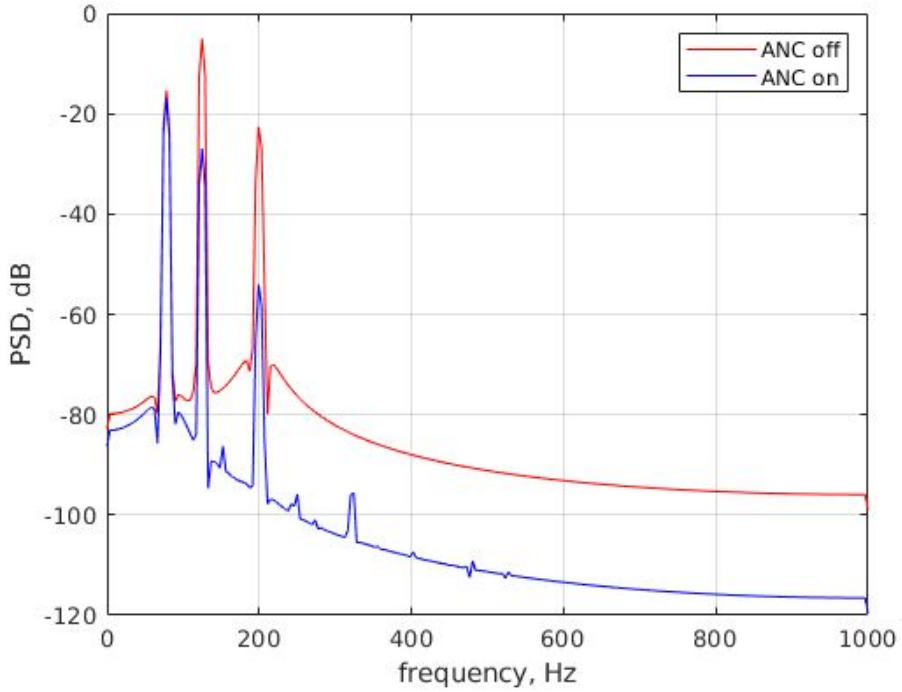
For single-tone sine signal we obtained following PSD:



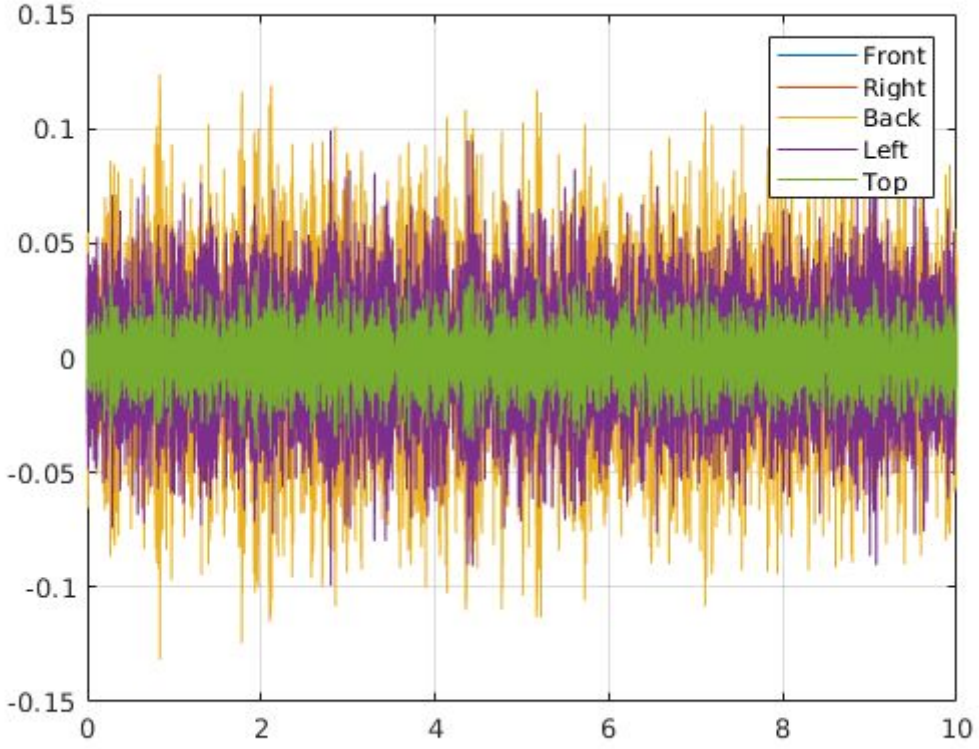
For multi-tone sine signal (based on addition of three sine waves) we obtained following results:

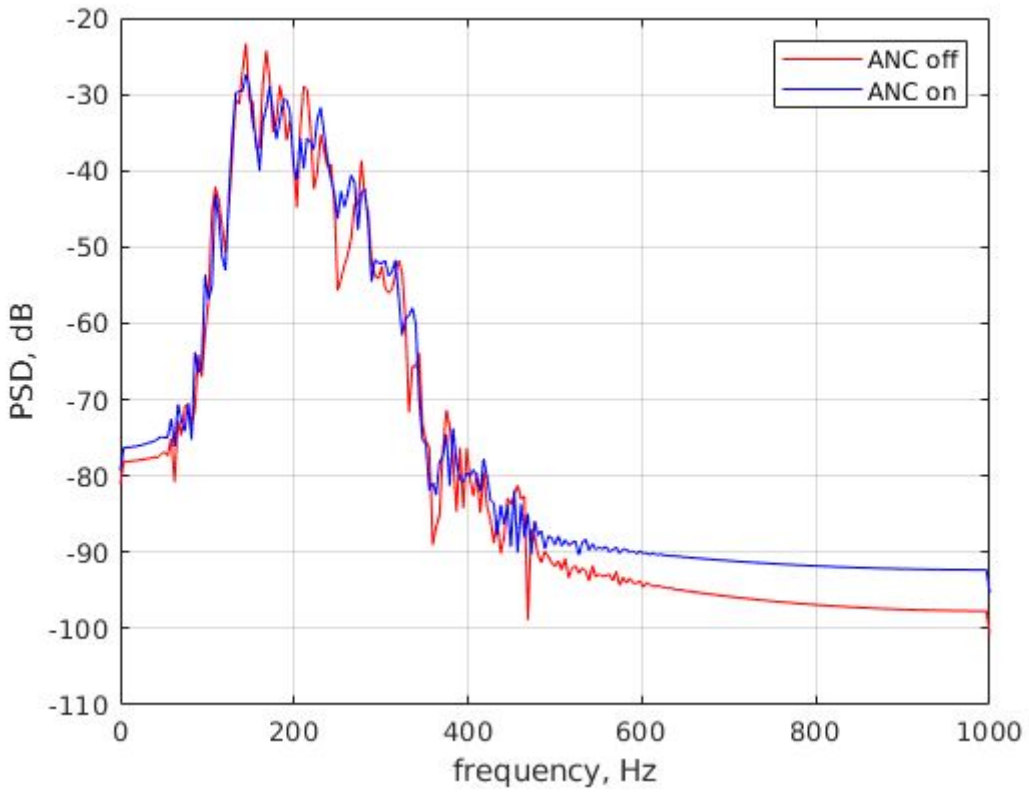


And PSD:



For band limited white noise:





We can see that in this time of experiment (10 seconds) there are no good results for white noise disturbances.

To be sure that we are simulating proper channels we ploted amplitude characteristics of each FIR filters taken to simulation: