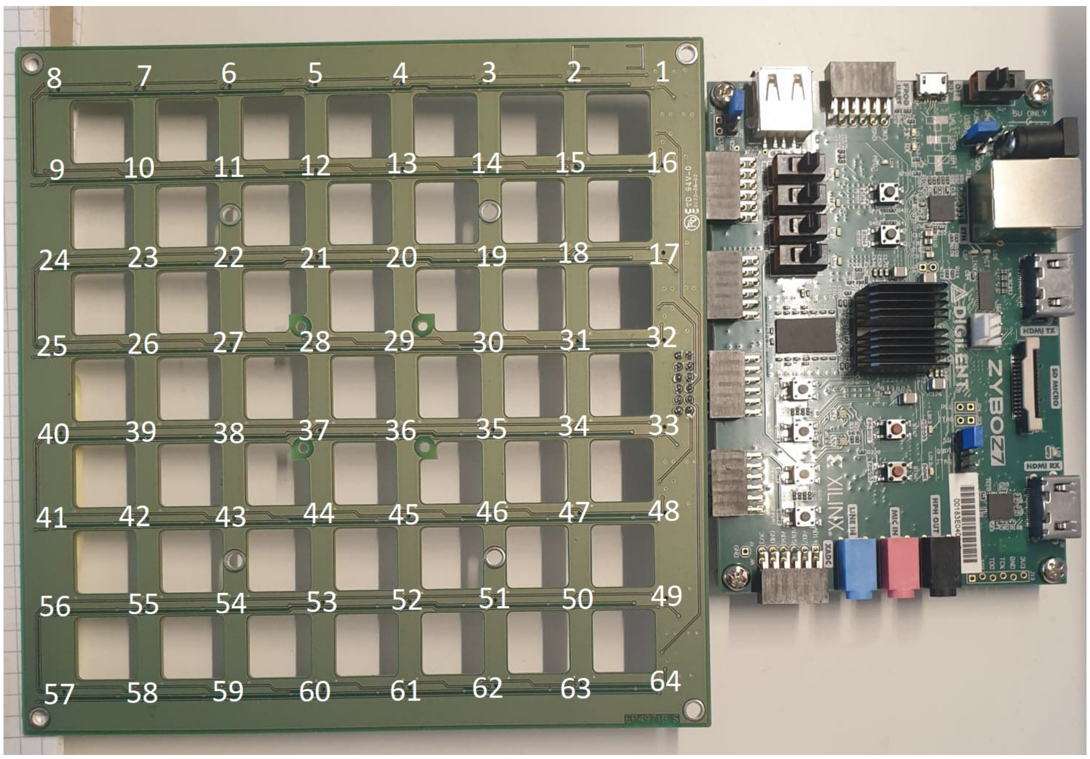
Testing the arrays - Version 2



Recommended tone generator: szynalski

Version of FPGA-sampling used during the tests: Github release

Download the release above or clone the Test_Manual_version branch

Use the following BOOT.bin version BOOT.bin version 1.1

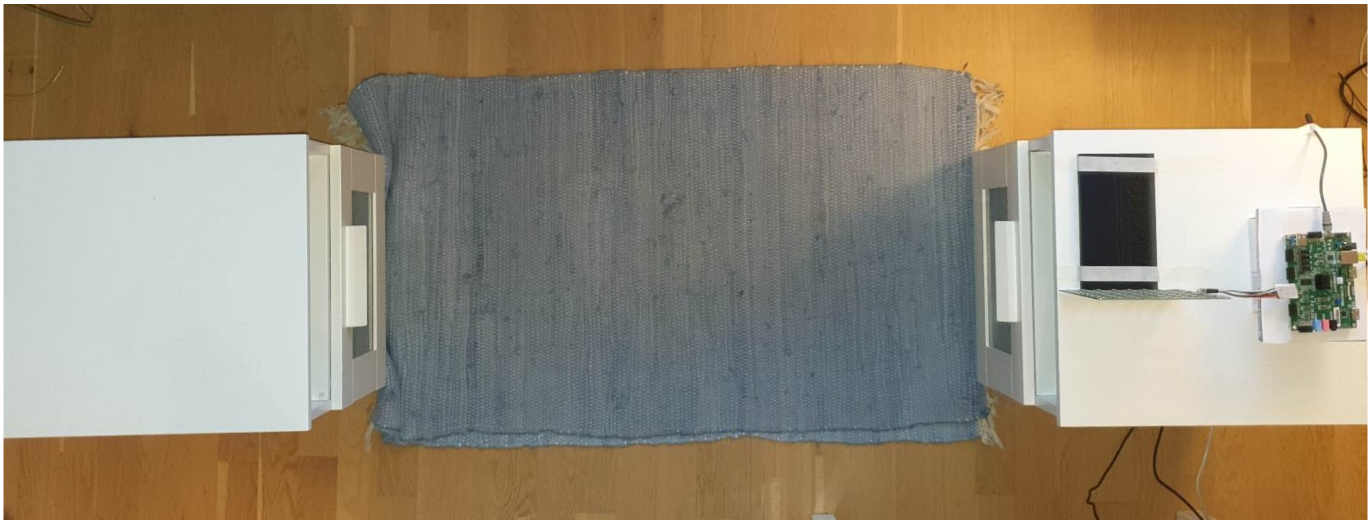
Checklist:

- Make sure the mini SD-card is inserted onto the FPGA, and that it is the right BOOT.bin.
- The JP5 pins on the fpga-board is set to SD.
- Make sure you have changed to the correct IP address on your PC. IPv4: 192.168.1.2 mask: 255.255.255.0.
- Also make sure you are using an open port on the PC.
- Turn on the power switch on the FPGA and after a few seconds the lights underneath the ethernet port should blink rapidly.

If you should need help with the installation or help to get the code running, please see the user manual under the project wiki. User-Manual

Test 3: Does the microphones sample data simultaneously, standing array

This is the same test as in *Testing the arrays version 1*, but this time the array is standing.



The main purpose of this test is to ensure that the microphones sample data at the same time. To investigate this the script calculates the phase difference for each microphone relative to the previous microphone. The array is built so that the microphones in a line are spaced 2 cm apart. Therefore the audio source needs to be placed in the same vertical plane as the array to make sure that the distance between each microphone maintains 2 cm.
Perform this test with multiple distances and frequencies of the audio source. Do several recordings before you move the audio source. Simply close the graph and a new recording is started immediately with the same settings entered at the start of the script. Repeat for other lines.

If the array and audio source are placed in the same vertical plane it makes it possible to estimate the phase difference of the microphones relative to the previous microphone. For example, if the frequency of the audio source is 880 Hz the phase difference for each microphone should be around 18.6 degrees, as can be seen in the equation below.

$$\phi = \frac{\Delta s}{v} \cdot 360^\circ \cdot f = \frac{0.02\text{ m}}{340\text{ m/s}} \cdot 360^\circ \cdot 880\text{ Hz} \approx 18.6^\circ \tag{1}$$

Results of test 3 (Standing array, PCBA1) with horizontal lines at 2 cm and 880 Hz audio source:

$$\phi = \frac{\Delta s}{v} \cdot 360° \cdot f = \frac{0.02 \text{ m}}{340 \text{ m/s}} \cdot 360° \cdot 880 \text{ Hz} \approx 18.6° \tag{2}$$

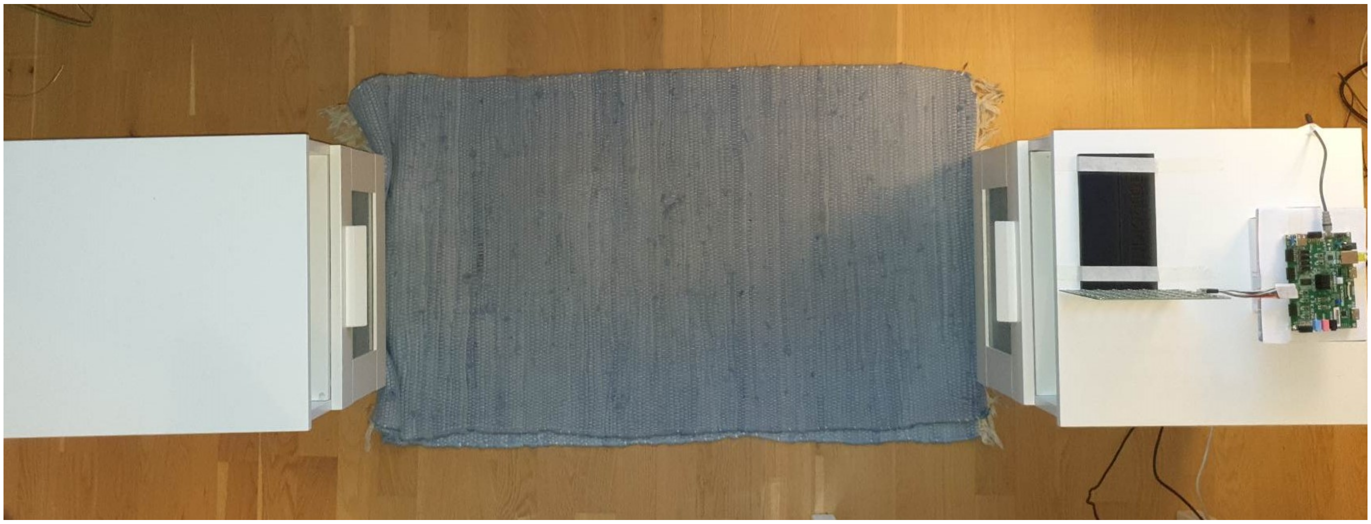
Test 3 standing. horizontal lines: 880hz audio source at 2 cm								
Line	Ref	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$
L1 $\rightarrow$	MK8: ref	MK7: 16.33°	MK6: 16.56°	MK5: 17.83°	MK4: 19.33°	MK3: 28.27°	MK2: 37.2°	MK1: 38.7°
L2 $\rightarrow$	MK9: ref	MK10: 18.19°	MK11: 16.96°	MK12: 17.56°	MK13: 20.47°	MK14: 26.39°	MK15: 32.83°	MK16: 31.28°
L3 $\rightarrow$	MK24: ref	MK23: 18.54°	MK22: 17.8°	MK21: 18.39°	MK20: 21.16°	MK19: 25.29°	MK18: 29.96°	MK17: 27.06
L4 $\rightarrow$	MK25: ref	MK26: 20.23°	MK27: 22.54°	MK28: 24.61°	MK29: 24.41°	MK30: 21.66°	MK31: 18.99°	MK32: 18.21°

Results of test 3 (Standing array, PCBA1) with horizontal lines at 1 meter and 880 Hz audio source:

$$\phi = \frac{\Delta s}{v} \cdot 360° \cdot f = \frac{0.02 \text{ m}}{340 \text{ m/s}} \cdot 360° \cdot 880 \text{ Hz} \approx 18.6° \tag{3}$$

Test 3 standing. horizontal lines: 880hz audio source at 1 m								
Line	Ref	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$
L1 $\rightarrow$	MK8: ref	MK7: 9.76°	MK6: 10.37°	MK5: 12.34°	MK4: 12.64°	MK3: 16.4°	MK2: 15.24°	MK1: 14.12°
L2 $\rightarrow$	MK9: ref	MK10: 17.18°	MK11: 21.9°	MK12: 47.24°	MK13: 58.98°	MK14: 23.35°	MK15: 10.19°	MK16: 4.26°
L3 $\rightarrow$	MK24: ref	MK23: 12.15°	MK22: 13.64°	MK21: 21.44°	MK20: 41.45°	MK19: 46.32°	MK18: 25.53°	MK17: 11.1
L4 $\rightarrow$	MK25: ref	MK26: 10.65°	MK27: 11.36°	MK28: 16.74°	MK29: 226.44°	MK30: 33.11°	MK31: 29.5°	MK32: 19.84°

Test 4: With a standing array and dedicated speaker, source at 3 meters

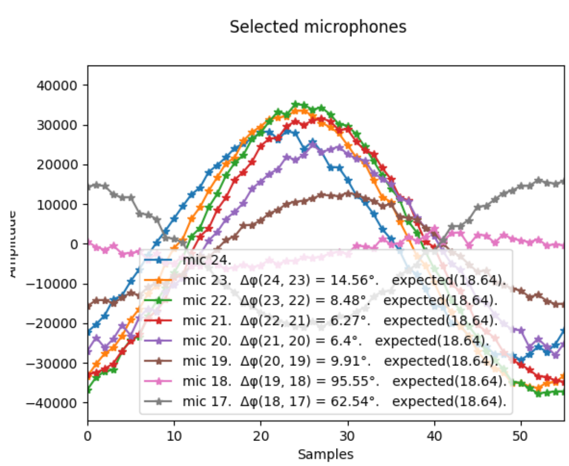


Place the speaker lined up with the lines of the array, just like in test 3 but with increased distance.

Results of test 4 with array PCBA1 with horizontal L3 at 3 m and 880 Hz with dedicated speaker source:

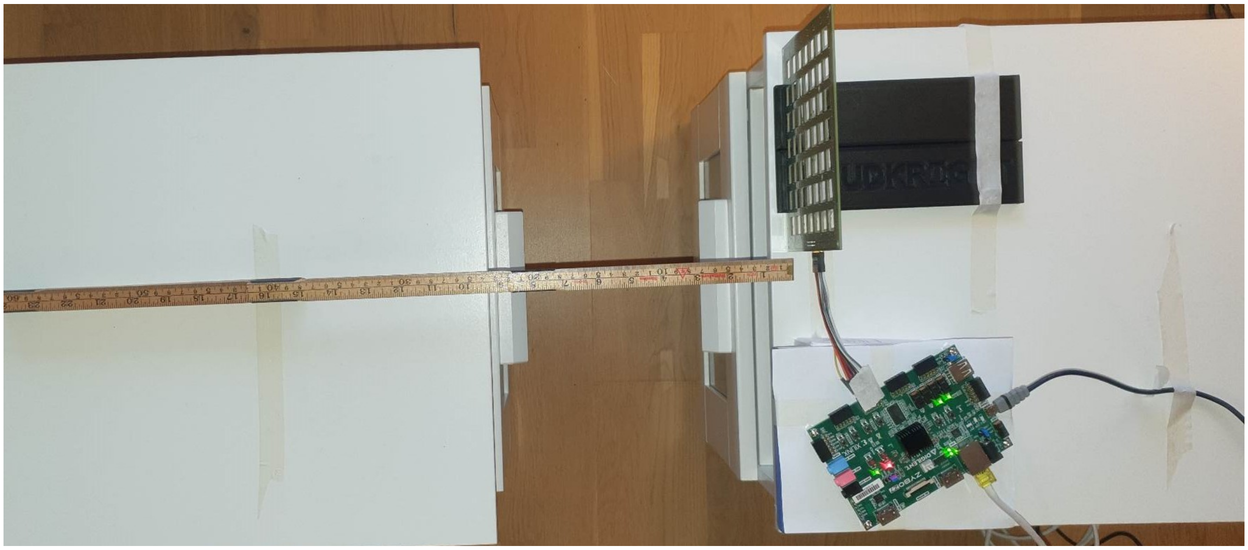
$$\phi = \frac{\Delta s}{v} \cdot 360° \cdot f = \frac{0.02 \text{ m}}{340 \text{ m/s}} \cdot 360° \cdot 880 \text{ Hz} \approx 18.6° \tag{4}$$

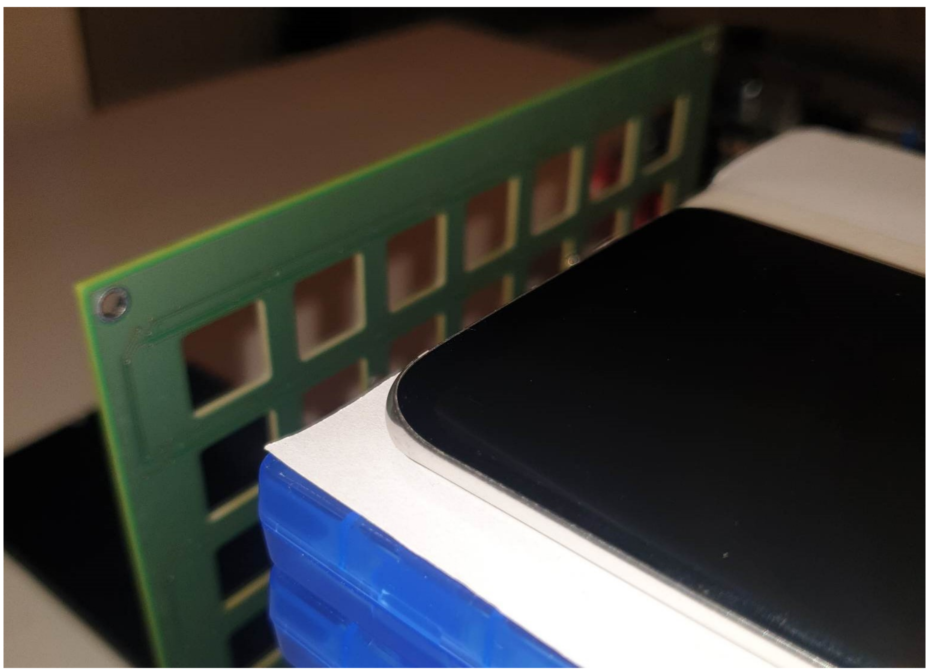
Test 4 standing. horizontal lines: 880hz speaker source at 3 m								
Line	Ref	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$	$\Delta\phi$
L4 $\rightarrow$	MK24: ref	MK23: 14.56°	MK22: 8.48°	MK21: 6.27°	MK20: 6.4°	MK19: 9.91°	MK18: 95.55°	MK17: 62.54°



1 Test 5: Comparing microphone pairs with the audio source facing the array

This test is an improvement of the *Bonus Test* from the first version. Place the audio source in the same vertical plane as the microphones to be compared. Make sure to have a good distance from the array and that the speaker is placed in the middle of the two microphones horizontally.





A longer distance is needed than what is shown in the picture, this short distance is just to clarify how the audio source should be placed

Results of test 5 with array PCBA1 with horizontal lines at 30 cm and 880 Hz audio source:

$$\phi = \frac{\Delta s}{v} \cdot 360^\circ \cdot f = \frac{0 \text{ m}}{340 \text{ m/s}} \cdot 360^\circ \cdot 880 \text{ Hz} \approx 0^\circ \tag{5}$$

Test 5. horizontal lines: 880hz audio source at 30 cm		
Line	Ref	$\Delta\phi$
L1 $\rightarrow$	MK8: ref	MK7: 0.39°
L1 $\rightarrow$	MK7: ref	MK6: 0.07°
L1 $\rightarrow$	MK6: ref	MK5: 0.31°
L1 $\rightarrow$	MK5: ref	MK4: 0.45°
L1 $\rightarrow$	MK4: ref	MK3: 1.36°
L1 $\rightarrow$	MK3: ref	MK2: 0.34°
L1 $\rightarrow$	MK2: ref	MK1: 0.96°