

# Demo 18: Inter-microphone distance

## Exercises

DSP Lab (EE 4163 / EL 6183)

Fall 2017

We use the cross-correlation of stereo channels to estimate the angle of arrival of an audio signal.

Demo files:

```
record_stereo.py
demo_two_microphones_01
stereo_aahh_in_class.wav
stereo_shshsh_in_class.wav
stereo_whistle_in_class.wav
```

## 1 Exercises

1. Read and run the Matlab demo file. Understand each step of the file. Run the file with each of the three provided wave files. (Nothing to submit.)
2. Make your own stereo recordings like the provided wave files. As in the Matlab demo file, use the stereo recordings to compute the time delay between the two microphones by finding the peak of the cross-correlation function. Convert the time delay to distance using the speed of sound. Is the distance between the two microphones accurately estimated?

You may record your own stereo signals by visiting the DSP lab. (The lab has two microphones set up and attached to the USB audio interface which can be connected to your laptop or lab PC). If your computer has two well-separated microphones, then you can use your own computer. You can use the Python program `record_stereo.py` to record to a stereo wave file.

TO SUBMIT: **Your stereo wave file. Plots of autocorrelation and cross-correlation functions. Show the peak of your cross-correlation function.** (Figures should be submitted as a single pdf file with multiple pages.)

3. Repeat the previous experiment, this time standing at a few different angles  $\theta$  with respect to the line formed by the two microphones (see Fig. 1). Using the known distance between the two microphones (measure the distance with a ruler) calculate the angle  $\theta$  ('angle of arrival') based on the time delay as measured by the peak of the cross-correlation. Does the calculated angle  $\theta$  agree with the true angle?

TO SUBMIT: **Plots of cross-correlation functions with the peak indicated.** (Figures should be submitted as a single pdf file with multiple pages.)

With your submitted work, include explanations and comments as an additional pdf file.

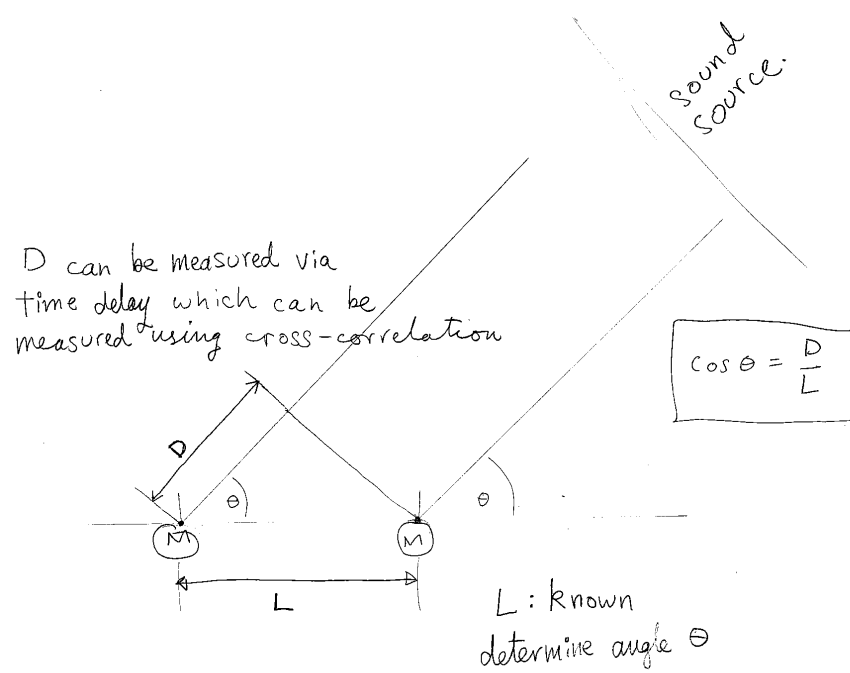


Figure 1: Two microphones and the angle of arrival.