Paint with Music

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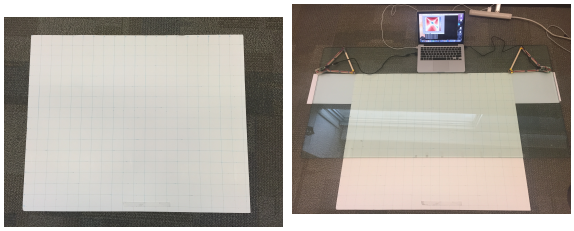


(a) 1 meter by 1 meter grid (b) arrays are placed at top left and top right corners

Fig. 1: Setup for circle movement localization

***Abstract*—The abstract goes here.**

I. Introduction

II. Experiment

To test localization accuracy, an one meter by one meter grid was set up and the arrays are placed at the top left and top right corners of the grid. Fig 1 shows a picture of the setup.

A total of 32 positions are chosen uniformly in this region where microphone data is recorded. To test how accuracy varies with window size, the algorithm is fed with recorded microphone data with different segment length. Fig 2 shows how accuracy changes with window length for three GCC algorithms. The error lowers as window size increases and plateaus after window size exceeds around 10 milli-second. The final average error is 2.53 cm inside the region (achieved with 12 millisecond window size with GCC_PHAT for delay estimation).

Although accuracy improves with window length, the calculation time also increases with window length. the calculation that depends on window length is the difference of arrival time calculation which uses cross correlation, and is of order $O(N \log N)$ by using Fast-Fourier-Transform. Figure 3 shows how the calculation time varies with window size.

Figure 4 shows a heatmap of the error distribution inside the one meter by one meter grid when window size is set to 12 milliseconds.

To test how well the arrays track movement inside the grid, a rotating disk 40 centimeter in diameter is mounted onto the grid at $(x = 0m, y = -0.3m)$. Fig 5 shows a picture of the sestup. A sound source is placed on the rotating disk and the arrays localizes the sound source as it moves in the circle. Three trials were performed with three different sound sources. In the first trial, white noise is used to set a baseline for audio sources, since our understanding is that white noise performs

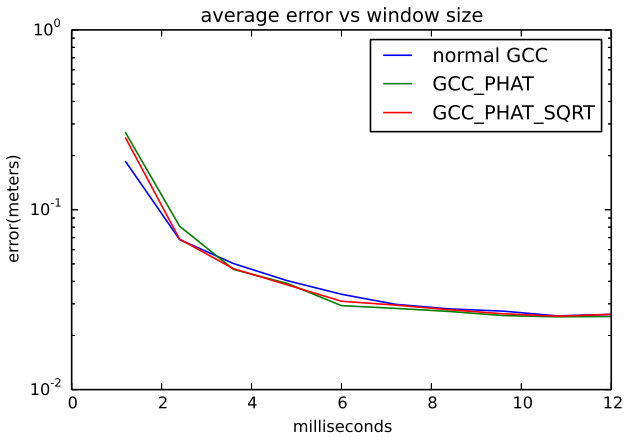


Fig. 2: accuracy versus window size

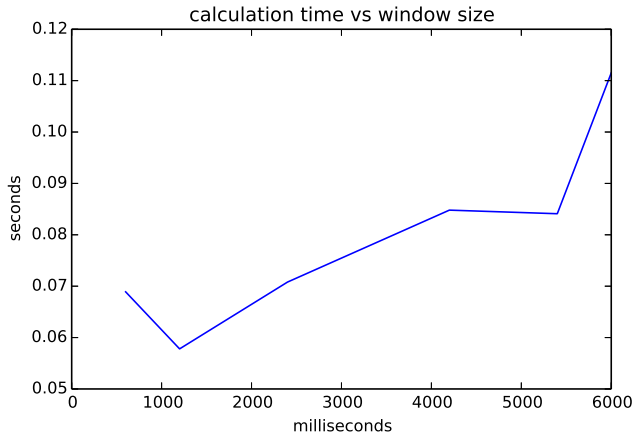
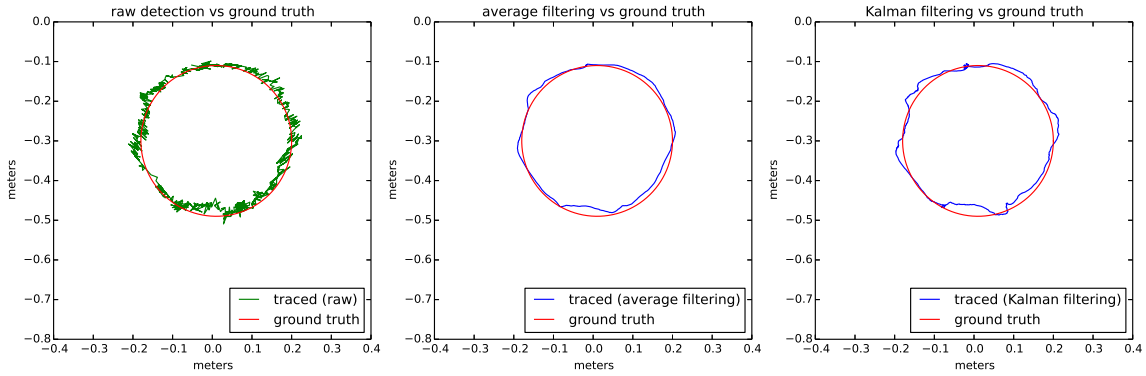
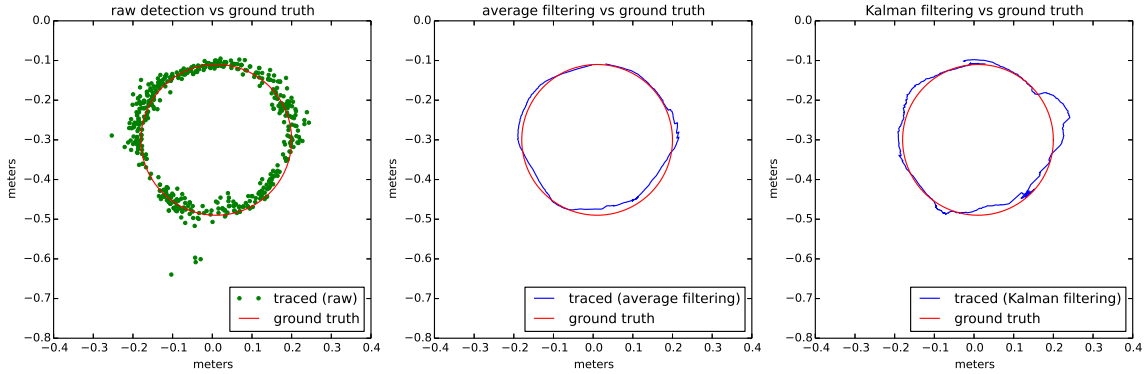


Fig. 3: speed versus window size

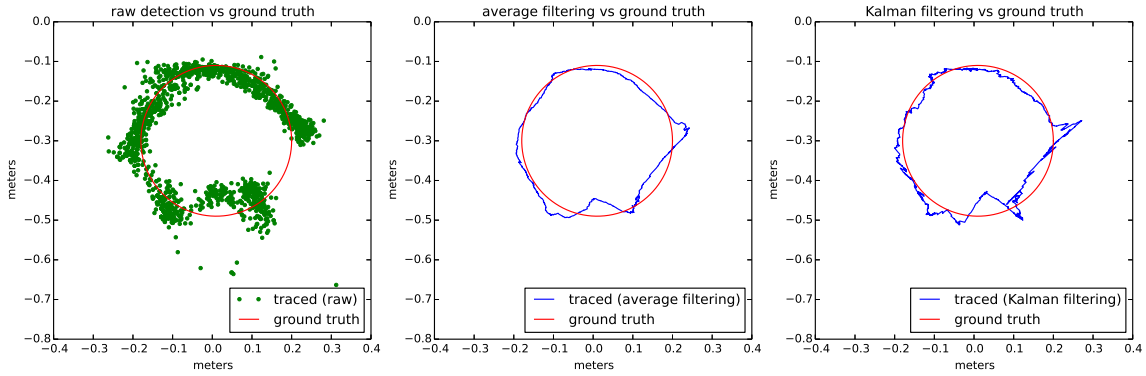
the best under GCC_PHAT. In the second trial, a randomly picked music is used. In the third trial, a music that contains low amplitude segments is picked to reflect real situations where people might use such music sources. Fig 6 shows the result for all three trials. As can be seen from the result, white noise does perform the best and the localized shape matches well with the shape of the rotating disk. There exists a bit of jiggling, but can be improved with filtering. Fig 6 also shows the result with averaging filtering and Kalman filtering. The result for music A shows



(a) white noise



(b) music A



(c) music B

Fig. 6: Localization of circle movement with different sound sources

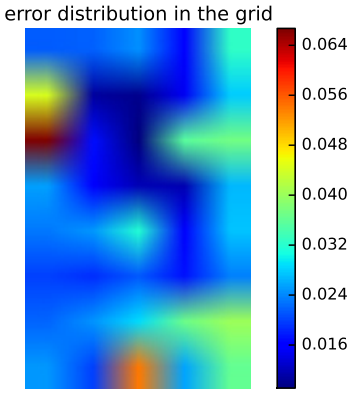


Fig. 4: error distribution in the grid

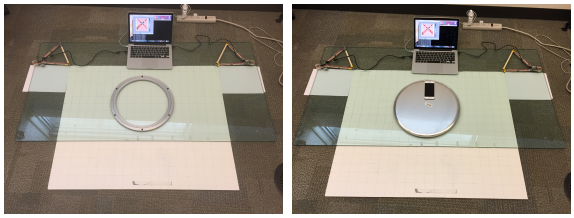


Fig. 5: Setup for circle movement localization

III. Conclusion

The conclusion goes here.

Acknowledgment

The authors would like to thank...

References

[1] H. Kopka and P. W. Daly, *A Guide to LaTeX*, 3rd ed. Harlow, England: Addison-Wesley, 1999.