Noise Source Localization on Planes

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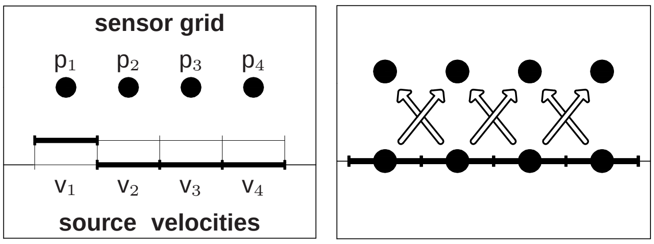
Introduction

Acoustic source localization techniques can play a vital role in understanding the causes of unwanted sound in technical products. Since these techniques are used in a measurement environment, stringent demands are placed on their speed, accuracy and ease of use. We present a fast, accurate and simple technique for reconstructing sources on a planar surface and compare results with an existing method.

Model



(a) physical model (b) distance: example

Figure 1: Model

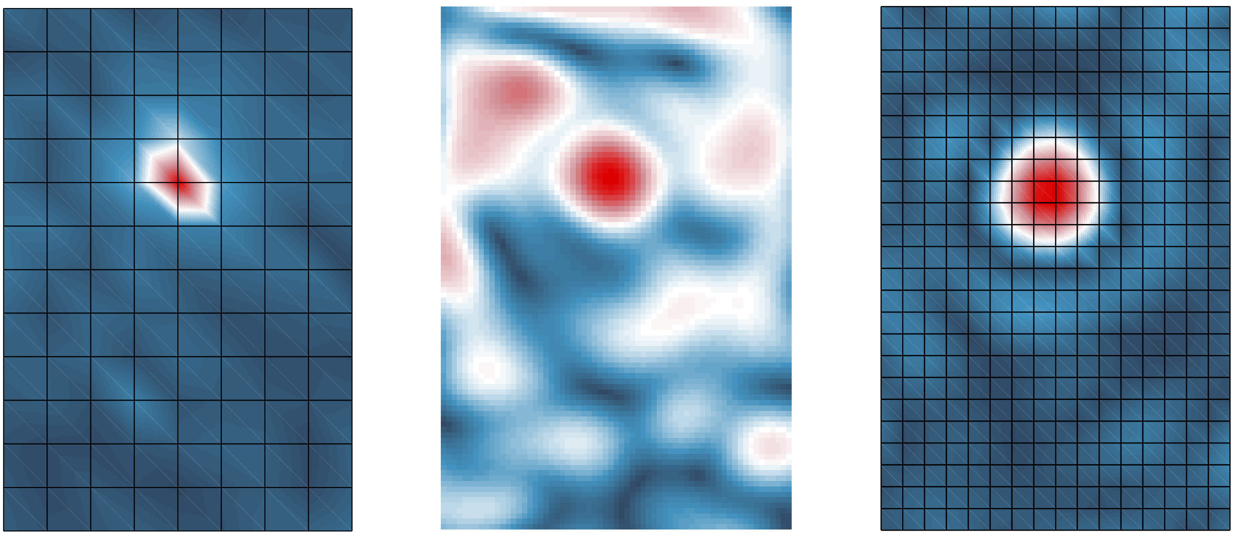
An acoustic source localization problem consists of finding the normal velocity vector on the source (**v**), based on the pressure vector (**p**) measured at a grid of points close to the surface (see figure 1(a)). Mathematically, this problem is solved by solving the system equations **p=Hv** for **v** using regularization techniques, where **H** is a known transfer matrix.

The existing technique makes use of the Fast Fourier transform (FFT) to approximate the transfer matrix. Even though this approach is very efficient, inherent problems such as aliasing and leakage can not be eliminated completely.

In a discretized problem, each element of the transfer matrix h_{ij} depends only on the distance between sensor location i and source point j. On an equidistant grid each distance occurs many times (see figure 1(b)), which leads to a highly structured transfer matrix. In our approach, we make use of this matrix structure to obtain a fast method without compromising accuracy.

Case study

The two methods are compared for reconstruction of acoustic sources on a hard disk and laser vibrometer measurement is used as a reference result. On lower frequencies, both methods have a similar accuracy but on the frequency of 10kHz, serious errors occur in the FFT-based method, where the new method is still accurate (see figure 2).



(a) Reference: laser vibrometer (b) FFT (c) New

Figure 2: Case study