Acoustic Imaging

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Introduction

Increasingly stricter government regulations and customer demands require silent products. As a consequence, manufacturers need to be able to predict and validate the sound field generated by their products to comply with legislation and customer requirements.
The current research focuses on the development of efficient measurement techniques and numerical algorithms to predict sound fields and corresponding surface velocity patterns of acoustic sources. The acoustic measurements will be performed with a novel acoustic velocity sensor, the microflown (Figure 1), invented by de Bree [1] at the University of Twente. Numerical algorithms will use these measurements to reconstruct the total sound field surrounding the product. With this information, modifications to the original product can be made to manipulate the acoustic field (e.g. minimize the radiated power).

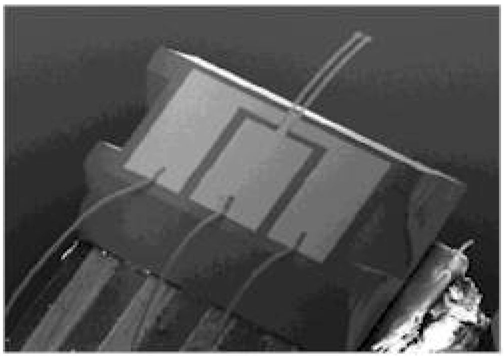

Figure 1: Microflown (≈ 2x2 mm).

Methods

When the surface vibrations of the acoustic source are known, it is possible to determine the sound field by direct evaluation of an integral equation. However in many cases the surface velocity pattern is unknown and inverse source identification based on acoustic measurements is needed. These inverse methods require recording of the sound field (acoustic pressure or velocity) on a measurement grid close to the surface of the acoustic source.
From these measurements the total sound field and normal velocity distribution at the source surface can be reconstructed. The current research is focused on the application of two methods: **nearfield acoustic holography** (NAH) and the **inverse frequency response function method** (IFRF).
NAH, see Williams [2], is a process which solves the inverse acoustic problem in an elegant way using fast Fourier transforms. IFRF is a more computationally intensive technique capable of solving the inverse problem even in case of an arbitrary shaped source and measurement grid. To decrease computational effort, application of fully efficient **multilevel algorithms** is investigated. Both calculation procedures tend to be highly ill conditioned and regularization methods are necessary to obtain a physically meaningful solution.

Acknowledgements

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References

[1] de Bree, H-E. (1997) The Micro own, PhD-thesis, University ofTwente.
[2] Williams, E.G. (1999) Fourier Acoustics, Washington D.C., Academic Press.