

## **MICROPHONE ARRAY METHODS FOR MUSICAL ACOUSTICS**

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### **ABSTRACT**

Measuring the radiating sound pressure at surfaces and sound holes of musical instruments can be performed using microphone arrays recording the radiated sound field around the instrument and back-propagating the measured pressures to the radiating surface or holes. Among the advantages of such a measurement setup are the preservation of the radiating surface by not attaching piezos or the like adding additional mass, the possibility to measure both, surfaces and sound holes at the same time, or when using a reasonable amount of microphones with high sampling rate to display transients at sound onsets. The main problem although is the back-propagation itself as this is an ill-posed problem. The main methods of multipole methods like the Minimum Energy Method (MEM), Helmholtz-Lease-Square (HELs) methods or Acoustic Holography (AH) try to overcome this ill-posedness using different approaches which again have pros and cons. While AH uses an angular spectrum back-propagating this spectrum with respect to its phases it has problems with evanescent waves which might appear with low frequencies already. HELs is using one virtual radiation point with many spherical harmonics overcoming the evanescent problem but with poor convergence and the need of very many harmonical functions. MEM uses as many virtual monopoles sources on the surface as there are microphones also overcoming evanescent waves with the need to distort these monopoles to overcome the ill-posedness of the problem. The paper shows examples of these methods for stringed, bowed and wind instruments.