CHARACTERISATION OF ACOUSTIC SOURCES WITH MULTI-SENSOR LINEAR ARRAYS.

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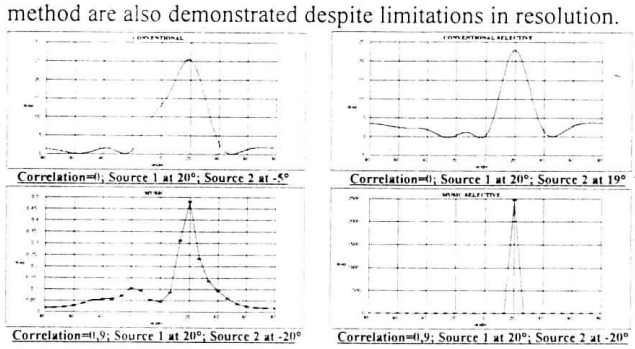
INTRODUCTION: The process of characterizing acoustic sources by means of a multi-sensor linear array is an established technique which permits the power and the spatial positions of sources to be evaluated. Processing techniques based upon several types of treatment in the frequency domain have been studied : Measurement systems and software based on conventional and high resolution methods have been developed. The conventional or classical method is simple and reliable but the resolution is limited for a restricted number of sensors. Consequently the high resolution techniques [1] were studied as an alternative to the classical approach. The results of experiments using these techniques showed the limits of the high resolution method when confronted with partially or totally correlated sources. In order to solve this problem, techniques based on the use of reference signals from selected sources were studied. In fact this approach consists of a pre-processing the cross spectral matrix in a specific way [2].

METHODS: The cross spectral matrix of the sensor signals may be expressed in terms of source reference signals and the frequency response functions between each reference and array sensor. Unfortunately, directly measured frequence response functions contain residual effects due to the correlation between sources and do not permit all problems of inter-source coherence to be resolved. This referential technique may, however, be applied to specific uncorrelated contributions from selected sources with a considerable gain in memory and calculation time. The proposed selective technique also uses reference signals but an extra conditioning process is applied to calculate the residual spectra which are uncorrelated with one or several sources. This permits an optimum characterization of partially correlated sources. The main difficulty in using these techniques is the choice of the reference signals when confronted with diffuse or complex sources.

RESULTS: In order to understand the physical phenomena associated with source correlation, numerical simulations and experiments were carried out for independent or partially coherent sources using different processing techniques. The results of the simulations show the improvements obtained with high resolution methods dealing with partially correlated sources. The advantages of this approach for the conventional method are also demonstrated despite limitations in resolution.



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THE ROLE OF MOUTH-TONES IN THE CONSTITUTION OF ATTACK TRANSIENTS OF MOUTH PIPES.

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Flue organ pipes and recorders are adjusted by the maker in order to produce initial "mouth tones" which, under the musician's control, may change the sound of the attack. The whistle has been isolated from the pipe itself, either by physical separation or by preventing the waves to propagate in the tube, and each part (mouth alone and entire pipe) has been played separately on a small organ which ensure a good reproducibility of the attack transient. Experiments have been carried out with several organ pipes and two recorders.

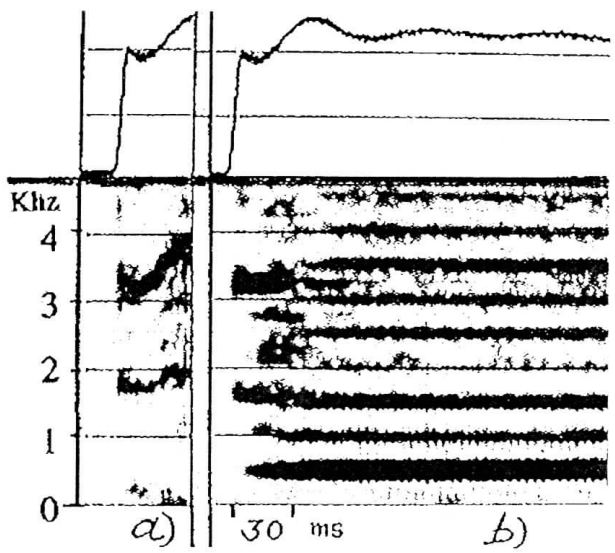

Figure1 - Upper part: pressure versus time; bottom: sonagram of mouth tone alone (left) and pipe tone (right).

By comparing the sound spectrograms it can be shown that:

1/ The mouth tones are always the first sounds produced by a mouth pipe.

2/ Their spectral components (frequencies, partial noise) are closely correlated to those produced by the whistle alone, under the same blowing conditions.

3/ The most stable frequencies of the mouth-tones correspond to the (inharmonic) frequencies of eigenmodes of the mouth pipe.

4/ At the time of appearance of the first harmonics of the pipe (H1 or H2), combination tones between these and that of the mouth tones are produced during several milliseconds.

5/ Although mouth tones usually disappear with the establishment of a periodic regime, they can remain through it as a complex, inharmonic treble sound. This effect is purposely looked for in the Italian tradition of organ-making (viola 4') and raises the difficult problem of the sustaining with the mouth two aperiodic regimes at the same time.

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