Real-time sound source localization using a cross-shaped microphone array

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This paper presents a real-time sound source localization system implemented on an FPGA using a two-dimensional microphone array. The objectives of the study are to design a beamforming-based algorithm capable of operating in real time and to assess its accuracy as a function of processing window length and microphone spacing. The method employs a cross-shaped array of two perpendicular linear microphone arrays and applies a delay-and-sum beamforming algorithm. Numerical simulations were conducted using both synthetic and recorded audio signals to evaluate performance. The results indicate that an analysis window of 1 second (45000 samples) and a microphone spacing of 150 mm achieve high localization accuracy across octave bands 1–9, with a maximum error below 4◦. In the highest considered octave band with a center frequency equal to 8000 Hz, errors exceed 10◦, suggesting that an additional low-pass filtering stage may be required. These findings demonstrate the effectiveness of the proposed approach for robust, real-time sound localization.