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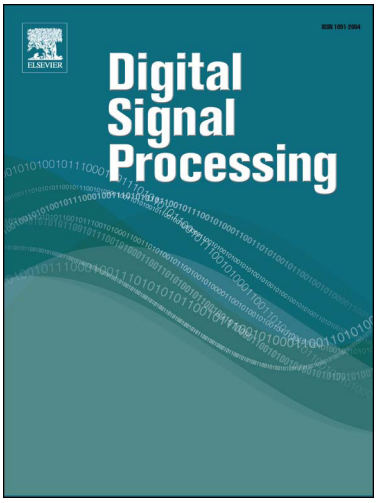

Closed-form solution to motion parameter estimation of an acoustic source exploiting Doppler effect

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Closed-form solution to motion parameter estimation of an acoustic source exploiting Doppler effect

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Abstract

This paper proposes an analytical solution for the parameter estimation of a moving acoustic source from the instantaneous frequency of a recorded signal on a ground located microphone. The acoustic source could be either a propeller-driven aircraft or a helicopter. During the transit of such acoustic source, the Doppler effect is exploited to estimate the speed, altitude, source frequency and the closest point of approach (CPA) time between the source and the microphone. The proposed solution is an original workout of an existing time-frequency based approach which has been applied previously to localize a propeller-driven aircraft. In contrast to existing solutions, the main advantage of the proposed one is the direct estimation of the flight parameters without resorting to any iterative procedure. The proposed approach is faster, less complex and therefore a good candidate for hardware implementation. The proposed solution is compared with respect to the existing approach in term of parameter estimation, performance and computation complexity. Experimental validations of the proposed solution are also presented.

Keywords: Acoustic localization, instantaneous frequency, Doppler effect, time-frequency analysis, closed form solution.