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Localization of Sound Sources in Combustion Chambers

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To optimize the efficiency and to minimize the emissions of pollutants, modern combustion chambers for aeroengines or stationary gas turbines run in high temperature ranges with lean fuel-air mixtures. The disadvantage of this combustion mode is its susceptibility to the formation of thermoacoustic instabilities. These self-excited oscillations are an unacceptable noise source and, furthermore, they reduce the durability of the combustion chamber significantly. The focus of this paper is the localization of combustion noise sources in enclosed combustion chambers. This can be achieved using the acoustical nearfield information from pressure measurements with wall-flush mounted sensors. The spatially bounded region, where the sound sources are suspected, is discretized by a grid of monopole sources. A system of linear equations for the source strengths is built based on the relations between the sound sources and the sound pressure field, theoretically caused by the assumed sources of the grid. The source strengths are calculated by inverting the system of equations. A spatial variation of the source grid allows the scan of likely regions of sound sources to finally deduce their original distribution. Numerical simulation results will be shown to illustrate the potential and the limits of the proposed method.