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Comparison of non linear system identification methods : the example of non linear propagation of acoustic waves in ducts

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The weakly non linear propagation of travelling acoustic waves in ducts is a well known problem leading to approximated analytical solutions. From an experimental point of view, the classical way for estimating the non linear parameters of propagation is to generate sine waves and to analyse the higher order harmonics as a function of the amplitude and the frequency of the excitation. In this work, new methods for estimating the non linear parameters of propagation are developed and compared to the sine excitation based method. The excitation signals associated to these new methods can be stationary noise or logarithmic chirps. For these excitation signals, the data processing is based on Multiple Input Single Output (MISO) direct path method. The comparison is made in terms of signal to noise ratio robustness and computation time. Experimental and theoretical results are also compared. We particularly show that a measurement using only one logarithmic chirp allows estimating accurate results for a broad band of amplitudes and frequencies. Associated computational time is then drastically reduced.