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Efficient method for harmonics estimation of car engine sounds: application to high quality real-time synthesis

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Additive synthesis is the most popular method for the resynthesis of sounds containing slowly evolving harmonics or partials, such as car engine noise and more generally rotating machines sounds. The most important step lies in the estimation of the amplitude and frequency of each sinusoidal component. It appears that insufficiently precise estimation often leads to unsatisfactory results in terms of sound fidelity. A method providing the time and frequency evolution of the amplitude of the harmonics of a recorded sound is presented. This technique is based on a joint time and frequency chaining of amplitude's extrema of amplitudes coming from a short-time Fourier transform, using forward and backward estimation. The proposed method is compared to a rough estimation, and to an estimation based on measured tachometric data, all carried out over the same car engine sound. This estimation method is implemented into the LEA software, which thus allows fast and precise computations of the parameters. Moreover, it also helps in estimating the frequency content of the "background" noise, which depends on the speed, allowing the extraction of the partials from the original sound in an easy and efficient way. Once these characteristics are found, a high quality real-time synthesis is possible.