An Approach to Mixed-Phase Synthesis from Modal distribution for musical instrument tones

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The Modal Distribution (MD) is a time-frequency distribution specifically designed to model the quasi-harmonic, multi-sinusoidal, nature of music signals and belongs to the Cohen general class of time-frequency distributions. The problem of signal synthesis from bilinear time-frequency representations such as the Wigner distribution has been investigated [1,2] using methods which exploit an outer-product interpretation of these distributions. Methods of synthesis from the MD based on a sinusoidal-analysis-synthesis procedure using estimates of instantaneous frequency and amplitude values have relied on a heuristic search 'by eye' for peaks in the time-frequency domain [3,4,5]. More recent work has applied the McCauley-Quatiere sinusoidal analysis procedure for automatic partial extraction to Modal distribution synthesis [6]. Being real-valued, the Modal distribution has no phase information meaning that subsequent signal synthesis from the Modal distribution must rely on magnitude and frequency components only. In this paper we show that the quality of synthesis produced from the real Modal distribution for certain classes of musical instruments results in signals with altered timbre quality exhibited as harshness or dullness when compared with the original signals. We observe that using a minimum phase or causal version of the signal can be shown to rectify this timbre distortion for certain individual tones but cannot be applied to any general class of instruments. A mixed-phase synthesis technique based on modelling instrumental sound as a causal and anti-causal decomposition is presented in [7]. We use such a decomposition for a comparative analysis of the timbral properties of the original and synthesised signals from the Modal distribution. We then suggest a method of phase recovery for synthesised timbres.

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