

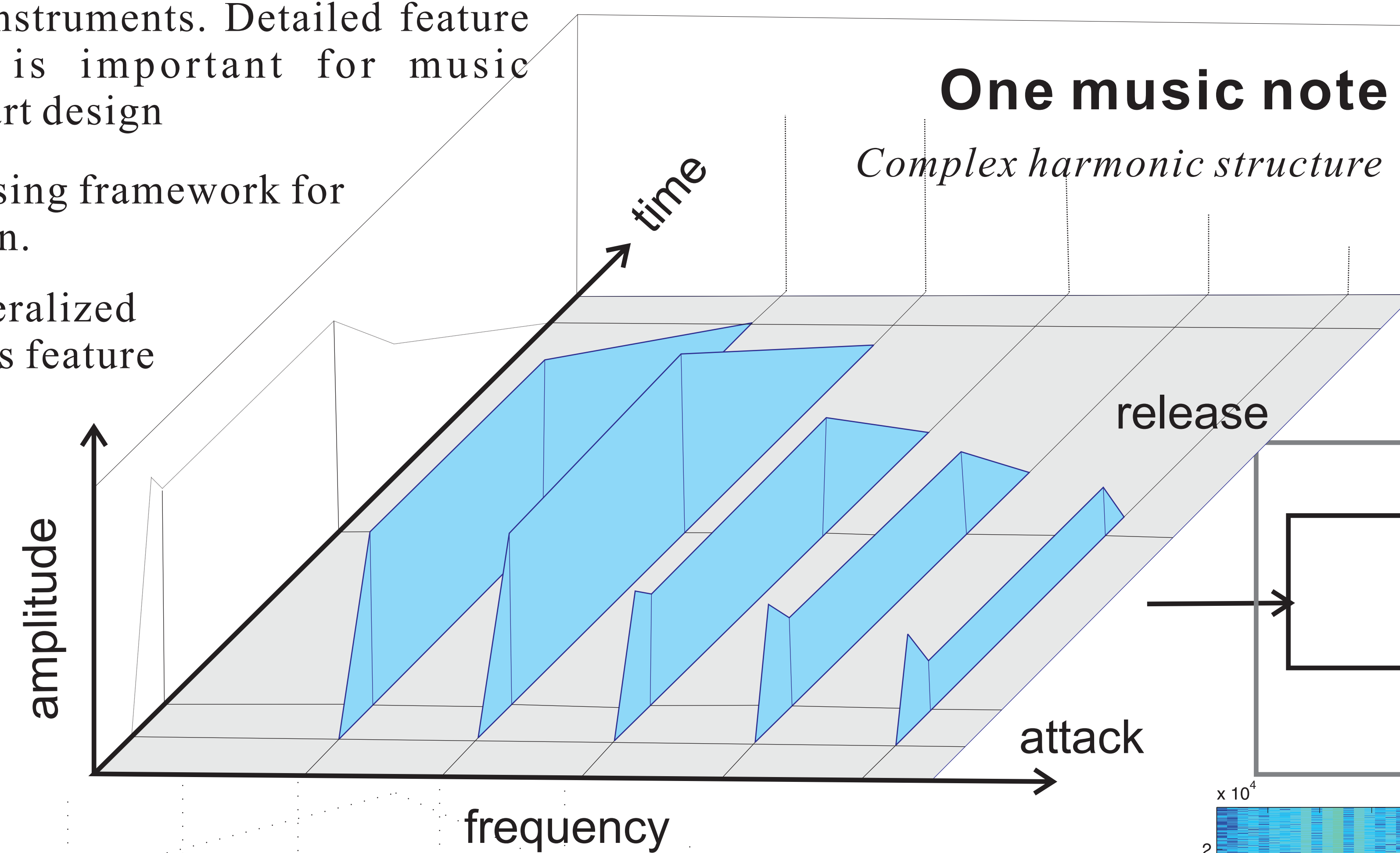
Parametric Analysis of Musical Vibrato in Voice and Instrument Performance

Mingfeng Zhang

Dept. of Electrical and Computer Engineering, Edmund A. Hajim School of Engineering and Applied Sciences, Univ. of Rochester

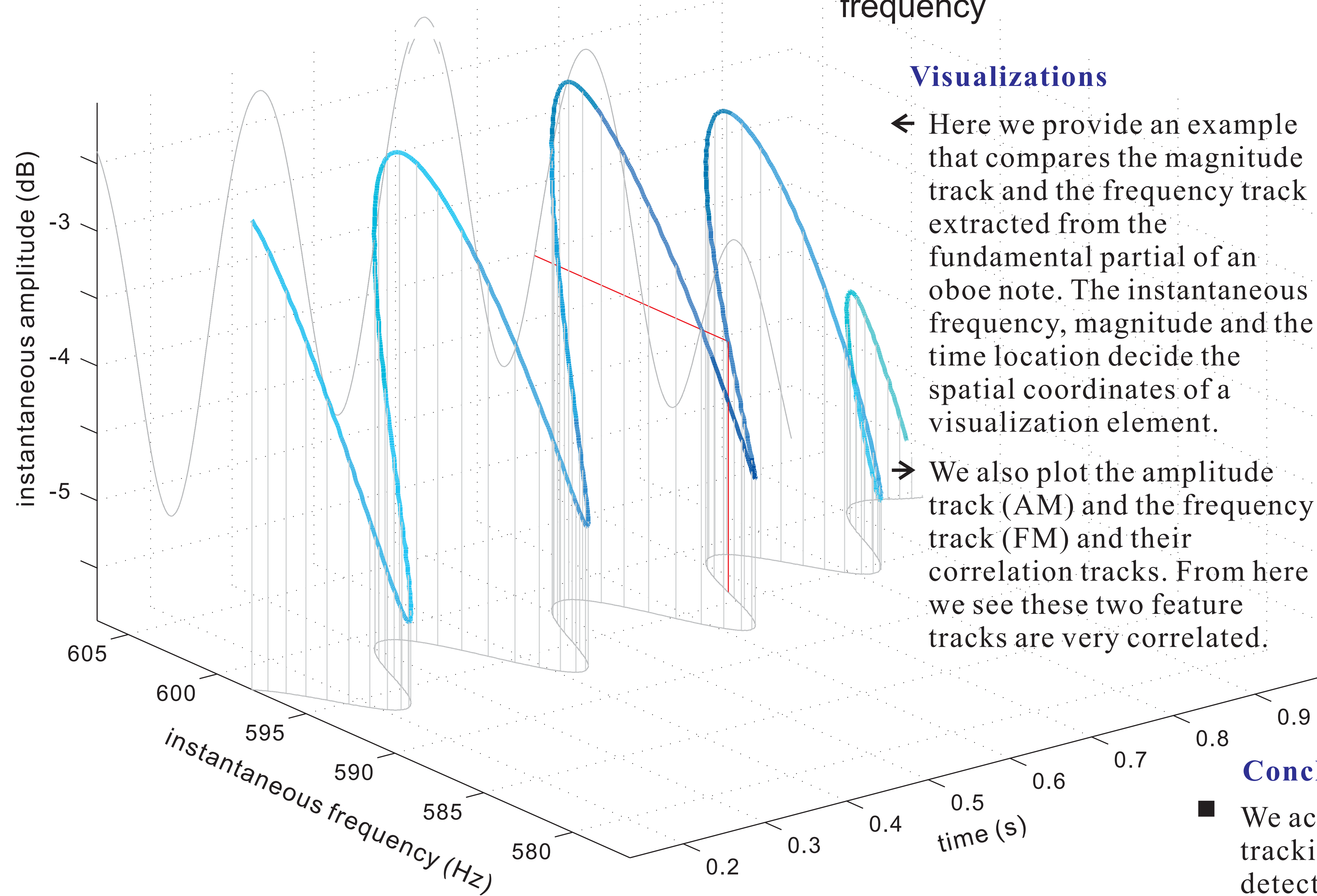
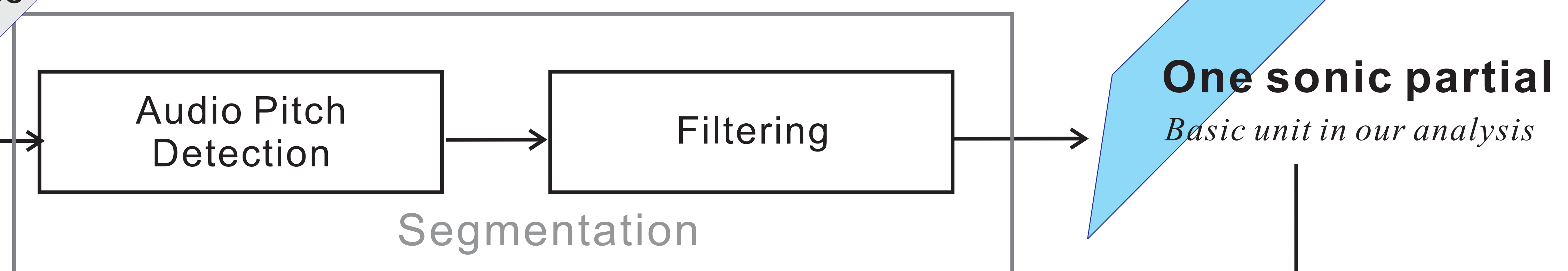
Introduction

- Vibrato is an important music performance technique for both voice and various music instruments. Detailed feature analysis and visualization is important for music performance training and sonic art design
- We implemented a signal processing framework for vibrato analysis and visualization.
- Music vibrato is treated as a generalized descriptor of music timbre and its feature dimensions are proposed.
- Visualizations of magnitude track and frequency track are presented for analysis. We also provide methods for comparing magnitude track and frequency track to understand their connections.



System Design

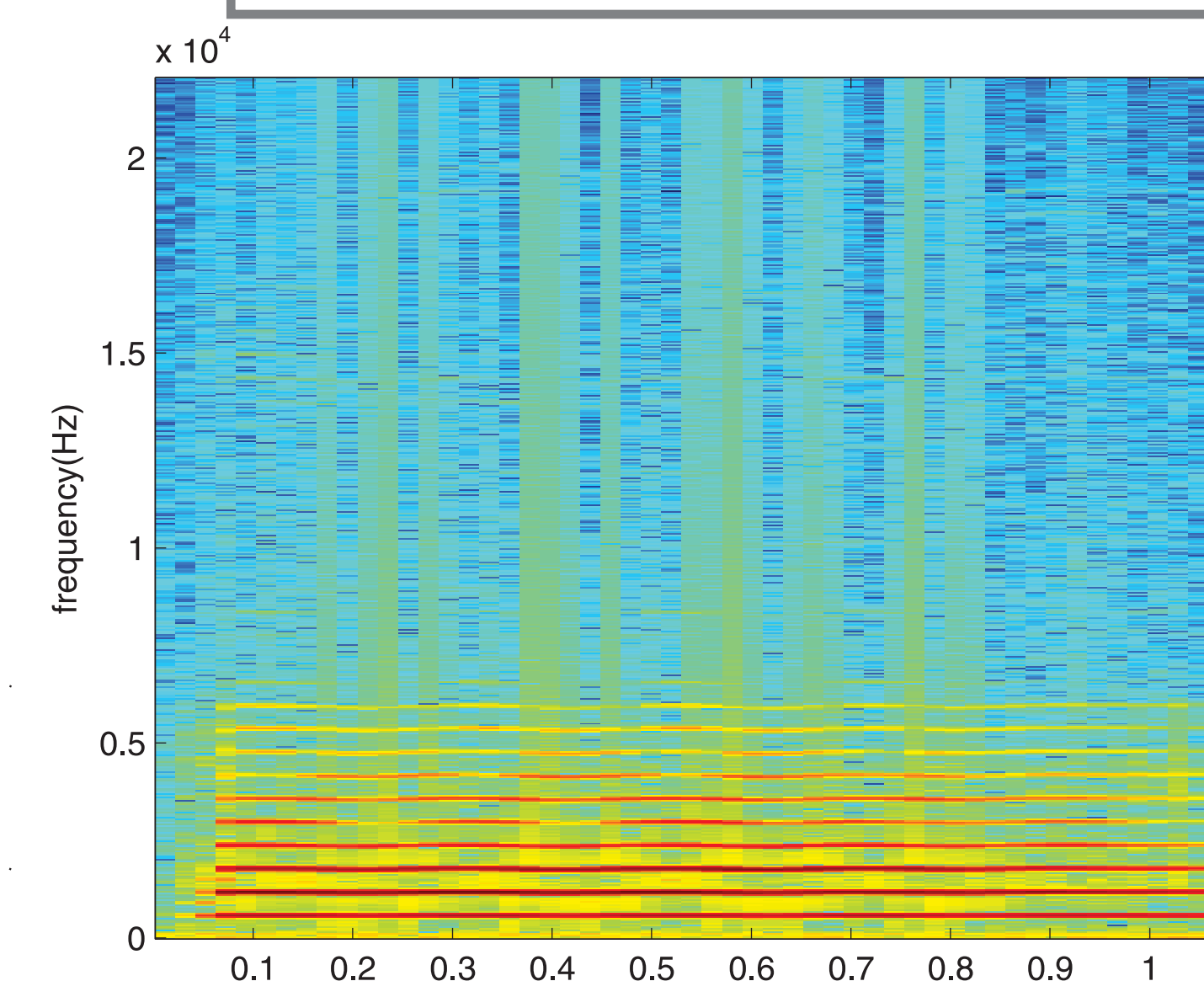
- We first detect the pitch of this music note as the basis for our analysis.
- We segment the music tones into harmonic partials using band-passed filters. The filter specification is designed to get a clear sonic partial from complex music tone.
- We then perform magnitude-frequency tracking algorithm from these segmented harmonic partials. Each separated partial overtones are modeled as a quasi-monochromatic component for feature extraction.



Visualizations

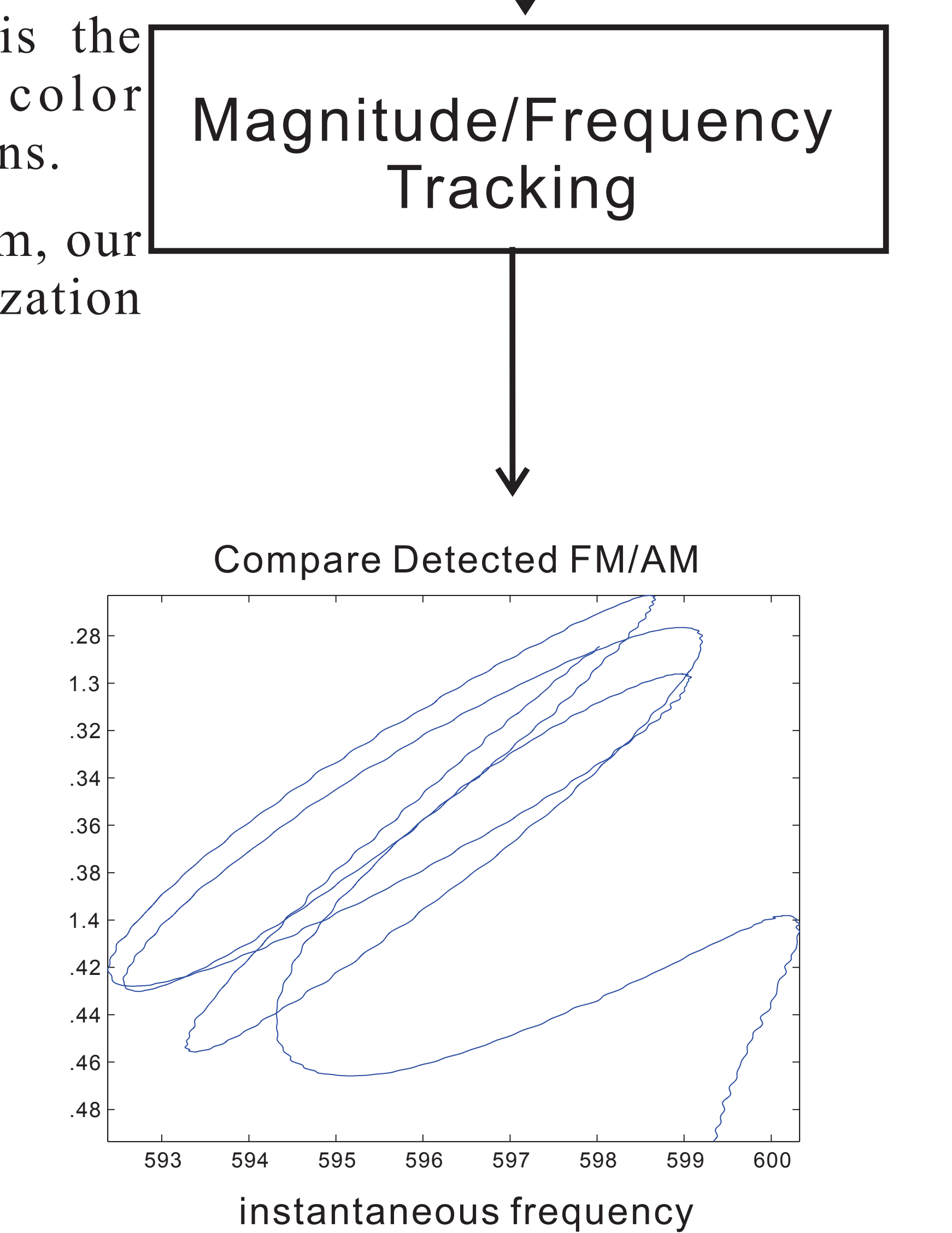
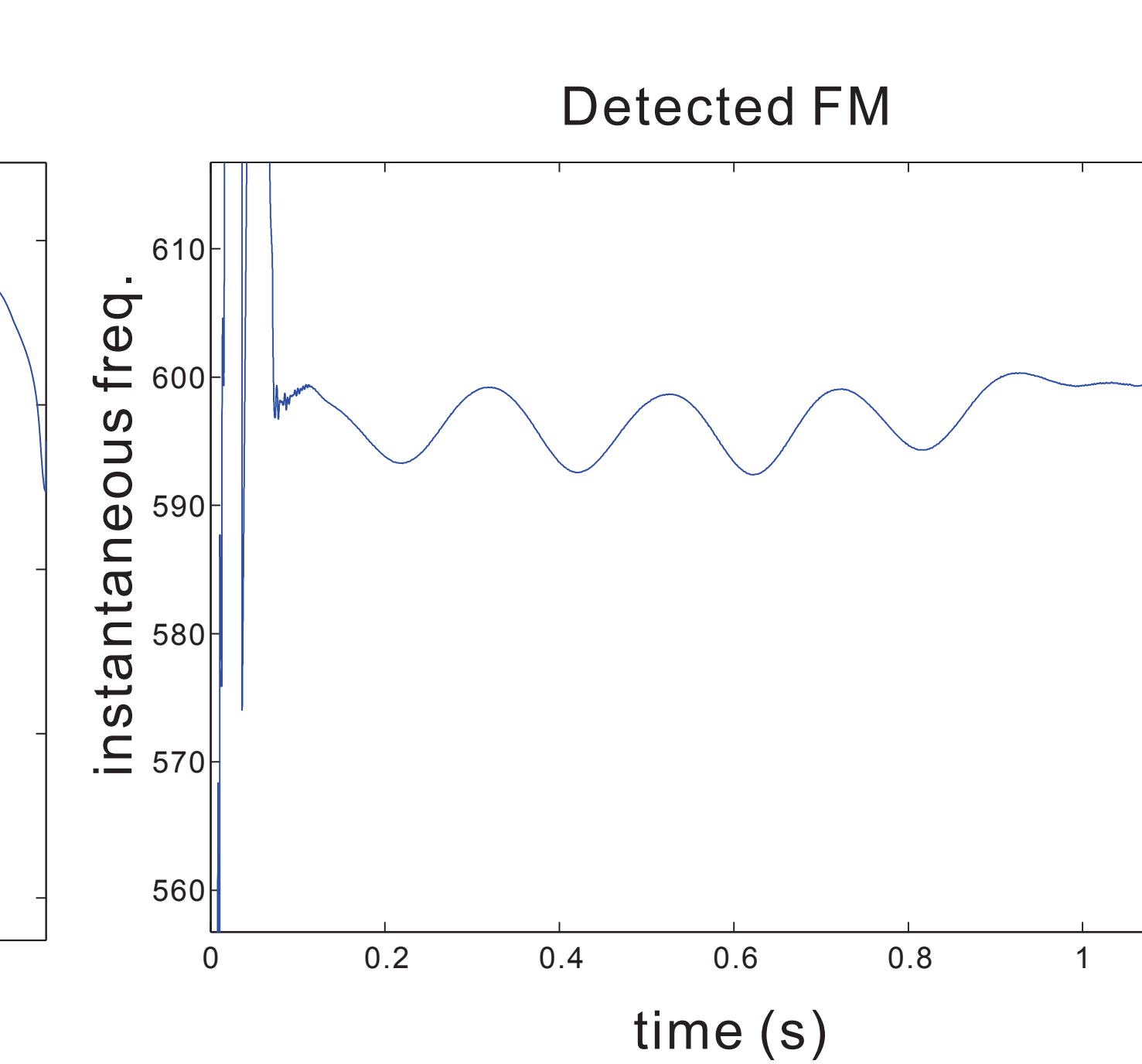
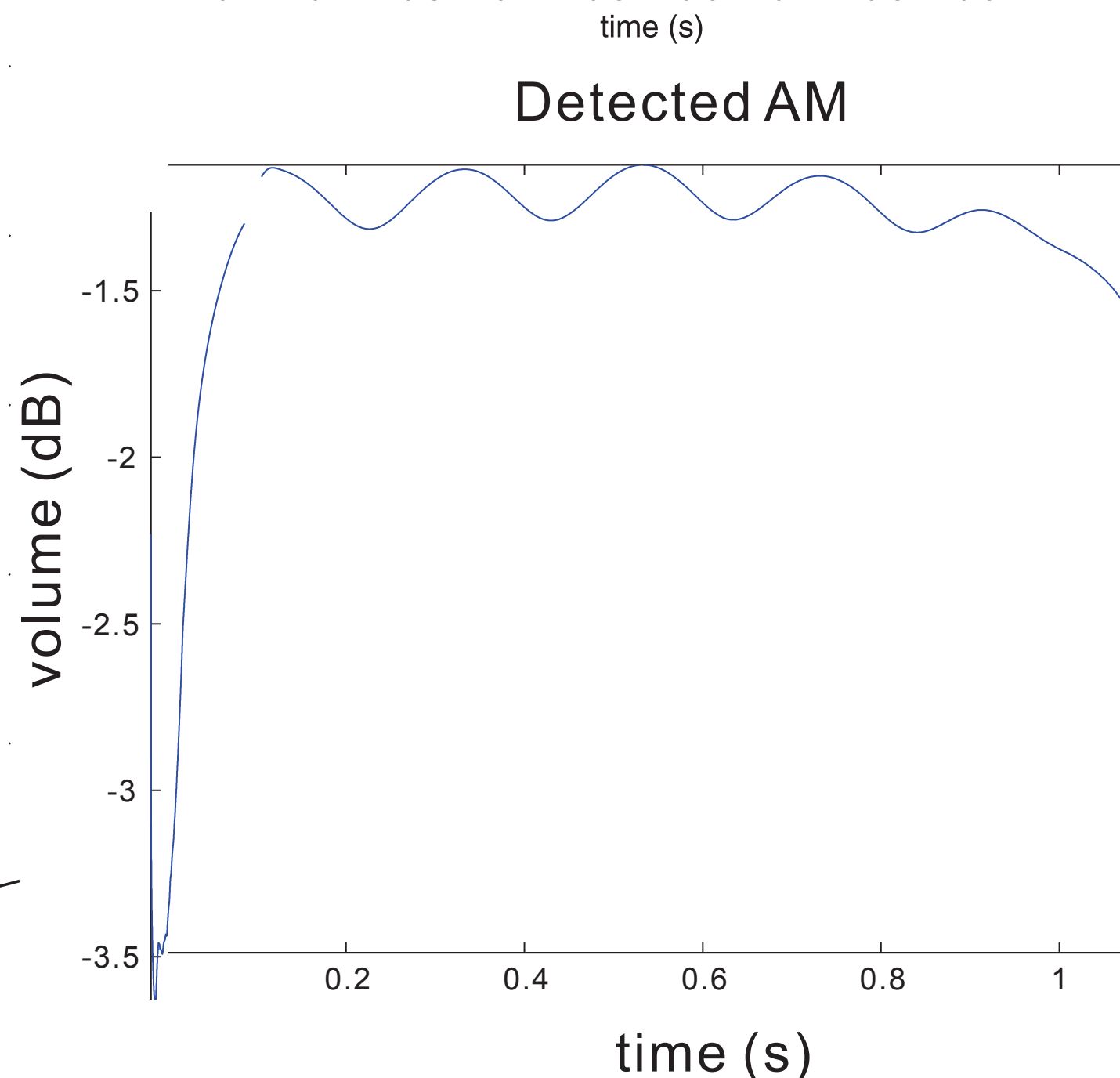
← Here we provide an example that compares the magnitude track and the frequency track extracted from the fundamental partial of an oboe note. The instantaneous frequency, magnitude and the time location decide the spatial coordinates of a visualization element.

→ We also plot the amplitude track (AM) and the frequency track (FM) and their correlation tracks. From here we see these two feature tracks are very correlated.



← In audio spectrogram, we can have a brief shape of the music vibrato. The up and down trajectory here is the frequency deviations. The color changes is the amplitude variations.

↓ Comparing the audio spectrogram, our proposed analysis and visualization provide enhanced resolution



Conclusions

- We achieve high analysis precision for both magnitude tracking tasks and frequency tracking tasks using the detection method based on analytic signals.
- These visualizations provide the detailed modulation structure of a note with vibrato. We can also observe the correlation between feature tracks.