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THE "DARK" ENERGY BETWEEN SONIC PARTIALS: MODELING AND VISUALIZATION OF WEAK SPECTRAL COMPONENTS FOR MUSICAL SOUND ANALYSIS AND SYNTHESIS

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BACKGROUND/SIGNIFICANCE: Most musical sounds exhibit robust energy concentrations, such as regular time-frequency patterns of sonic partials, as a sparse energy distribution across the spectrographic analysis plane. Most musical sound studies present strong spectral components with respect to energy distribution patterns of the harmonic partials. However, between any two sonic partials, most musical sounds show interesting low-energy signal patterns such as wide-band articulation or other performance nuisances. Computational analysis tools and in-depth studies are required for understanding these low-energy signal patterns.

OBJECTIVE/HYPOTHESIS: Implementing computational tools for understanding the low-energy signal patterns from music instrument sound samples. Specifically, we want to implement (1) signal detection methods for the low-energy signal patterns, and (2) visualization-based analysis of these signal patterns. We expect the low energy components to show different signal patterns from the strong energy components.

STUDY DESIGN/METHODS: The study starts with a collection of sound samples from musical instrument datasets. Then we implemented a harmonic partial identification algorithm that obtains the frequency locations of the harmonic partials (strong signal components). A sonic partial masking module is implemented to interpolate the signal energy of the adjacent time-frequency regions and replace the frequency locations of the strong signal components. From these steps, we obtained a matrix-based representation of the time-frequency energy distribution of low-energy signal component. A visualization module is implemented for exploring and interacting with these low-energy signal components and their representations.

RESULTS: The authors implemented a musical signal analysis framework that extracts these low-energy spectrographic components by detecting and masking-off the strong sonic partials and forms computational representations for these low-energy signal components. Visualizations of the obtained representations show interesting signal patterns different from the conventional studies performed on the strong signal components.

CONCLUSIONS: The low energy-signal patterns contain a lot of useful information complementary to the conventional musical timbre studies. Further investigations in this area will

help musicians better understand how to create sonic concepts and aid in the mastery of creating more realistic electronic/computer instruments, broadening our understanding of musical timbre and musical performance expressions, while enhancing the naturalness, expressiveness and creativeness of electronic/computer music systems.