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2010 - CS021
BEATHOVEN: IDENTIFYING AND INVENTING SOLUTIONS TO OBSTACLES HINDERING AUTOMATIC TRANSCRIPTION OF POLYPHONIC MUSIC OF A SINGLE INSTRUMENT
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Automatic music transcription, the computerized translation of digital music to sheet music, has long remained an unsolved problem. Attempted solutions have either made unreasonable assumptions or been based on heuristics not generally applicable. The purpose of this research was to develop a mathematically rigorous application to solve automatic transcription of polyphonic music of a single instrument.

We created a test bed of music, climbing from notes to chords to full musical pieces, and tested the accuracy of a variety of algorithms, both original and established, on these music files. We are now working on finalizing and optimizing those algorithms that appeared most theoretically and practically sound.

Myriad obstacles to automatic music transcription exist, of which the most significant are frequency detection, overtone elimination, and phantom fundamental construction.

Frequencies present must be detected, as frequencies correspond to musical notes. Current frequency detection algorithms descend from the Fourier transform, subject to the Fourier Uncertainty Principle: they cannot accurately detect the frequencies of short notes. We are developing a promising solution to frequency detection by constructing a multidimensional convex polytope using a modified phase-I Simplex algorithm.

Most musical notes have both fundamental frequencies and overtones. Overtones do not represent notes played and must be eliminated. Some notes have only overtones without a fundamental. According to psychoacoustic theory, the ear will hear the “phantom” fundamental, so these missing frequencies must be constructed. We are exploring the relationship between the phases of fundamentals and overtones as a method to identify overtones and phantom fundamentals.

Awards won at the 2010 ISEF**********
Fourth Award of $200 - Association for Computing Machinery
Third Award of $350 - IEEE Computer Society
Fourth Award of $500 - Computer Science - Presented by Intel
Award scholarship of $5,000 - Oregon Institute of Technology