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3.1.06
ISE 599

Tempo and Loudness Analysis of a Continuous 28-Hour Performance of Erik Satie's Composition "*Vexations*"

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In 1893, Erik Satie composed an enigmatic three-part piece entitled "Vexations." The most incredible feature of the piece is the instruction inscribed at the top of the score to play a single motif "840 times in succession." Though the intent behind this piece is controversial, several performances have been carried out, ranging from 5.48 to 24.46 hours in length. The first aim of this study is to examine a continuous 28-hour performance of "Vexations" in order to study global changes in tempo and loudness in a performance of extreme length. In addition, due to the repetitive nature of "Vexations," the authors also wish to study on a local level whether note duration and loudness vary systematically over time. The third purpose of the study is to develop and explore adequate methods for long-term performance analysis. Such methods would allow for the testing of the hypothesis that human motor systems are inherently oscillatory.

The composition was performed by a 40-year-old professional pianist who had previously performed the piece. Data was recorded using a Yamaha grand piano with built-in MIDI interface. MIDI and acoustic data were recorded onto hard disk. Loudness curves in sones were calculated from the WAV file data. Since the piece contained only three note lengths, IOIs were mapped to eighth, quarter, or dotted-quarter notes according to time thresholds determined by the minima between three peaks of the IOI distribution.

The loudness and tempo data were divided into three distinct cognitive states of the pianist: alertness, trance, and drowsiness. These states were determined by behavioral and EEG data of the pianists recorded throughout the performance. The authors utilized an autocorrelation function to determine periodicities in the data. Additionally, they embedded the time series data into an *m* dimensional space where *m* was defined as the dimension at which the correlation dimension converged. I found the discussion of embedding to be somewhat confusing and complicated. It is still unclear to me the exact purpose of this procedure, but it seems as though embedding into higher dimensional space allows for the examination of similarity between the repetitions of the motif over time. It also appears to help determine whether there is a deterministic relationship between all of the repetitions, or whether their variation is simply random noise.

The results of the analysis showed that tempo remained remarkably steady during the first 15 hours of the performance. However, in the trance state, there was a slight increase in tempo and in tempo instability. The state of consciousness had a strong effect on average tempo stability, as expected. With regards to loudness, there appeared to be an overall, continuous decline in loudness over the first 18 hours of the performance. Again, in the trance section, the loudness curves were characterized by greater instability. On a more local level, the performed loudness seemed to be independent of note duration. In addition, tempo-loudness trajectories showed that tempo and loudness varied independently throughout the performance.

In conclusion, I found much of this paper to be rather perplexing. I am not exactly sure what was accomplished. The authors believe that their embedding of the time series data into 18 dimensional space showed that changes in tempo and loudness are highly complex in nature. They claim to have demonstrated an underlying periodicity on a large time scale, which they attribute to physiological sources. They suggest their embedding procedure shows that these oscillations are deterministic in nature. I am somewhat skeptical of their claims, because I feel they have stretched the complexity of their analysis a little too far. Not only are the methods complex, the experiment itself seems somewhat a little unrealistic.