Play It Again: A Case-Based Approach to Expressivity-Preserving Tempo Transformations in Music

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Abstract. It has been long established that when humans perform music, the result is never a literal mechanical rendering of the score. That is, humans deviate from the score. As far as these performance deviations are intentional, they are commonly thought of as conveying musical expressivity which is a fundamental aspect of music. Two main functions of musical expressivity are generally recognized. Firstly, expressivity is used to clarify the musical structure of the piece (metrical structure, phrasing, harmonic structure). secondly, expressivity is also used as a way of communicating, or accentuating, affective content.

An important issue when performing music is the effect of tempo on expressivity. It has been argued that temporal aspects of performance scale uniformly when tempo changes. That is, the durations of all performed notes maintain their relative proportions. This hypothesis is called relational invariance (of timing under tempo changes). However, counter-evidence for this hypothesis has been provided, and a recent study shows that listeners are able to determine above chance-level whether audio recordings of jazz and classical performances are uniformly time stretched or original recordings, based solely on expressive aspects of the performances. In my talk I address this issue by focusing on our research on tempo transformations of audio recordings of saxophone jazz performances. More concretely, we have investigated the problem of how a performance played at a particular tempo can be automatically rendered at another tempo while preserving its expressivity. To do so we have developed a case-based reasoning system called TempoExpress. Our approach also experimentally refutes the relational invariance hypothesis by comparing the automatic transformations generated by TempoExpress against uniform time stretching.