DIRECTOR MUSICES (ACCENT-BASED FORMULATION)

1. BACKGROUND

Our model is an extended version of Director Musices, a performance rendering system that introduces expressive deviations into input score files. By incorporating the accent theory of Parncutt (2003) into previous formulation of the system, new rules allow to mathematically model timing and dynamics in the vicinity of immanent accents, i.e. local musical events that attract a listener's attention.

2. SYSTEM OVERVIEW

2.1 An Accent-Based Approach to Automatic Rendering of Piano Performance

Accents are local events that attract a listener's attention and are either evident from the score (immanent) or added by the performer (performed) [1]. Immanent accents are associated with (temporal, serial) grouping (phrasing), metre (downbeats), melody (peaks, leaps) and harmony (or dissonance). In piano music, performed accents involve changes in timing, dynamics, articulation, and pedalling; they vary in amplitude, form (amplitude as a function of time), and duration (the period of time during which the timing or dynamics are affected).

The relationship between immanent and performed accents is that performers tend to "bring out" immanent accents, i.e. to attract the listener's attention to them. For example, a performer may slow the tempo or add extra time in the vicinity of certain kinds of immanent accent, or change dynamics or articulation in consistent ways. This relationship is complex and depends on many factors such as musical and personal style, local and cultural context, intended emotion or meaning, and acoustical and technical constraints.

2.2 An Accent-Based Formulation in Director Musices

Director Musices (DM) [2] comprises performance rules (mathematically defined conventions of music performance) that change specific note properties, including timing, duration and intensity. By manipulating program parameters, meta-performers can change the degree and kind of expression by adjusting the extent to which each rule is (or all rules are) applied.

Several of the rules presented in DM can be interpreted in terms of Parncutt's taxonomy of accents. This suggests that a conflation of the two models may yield new insights into expressive performance and possibly lead to artistically superior computer-rendered performances. The main feature of our new model in DM is to relate expressive features of a performance not only to global or intermediate structural properties (i.e. different levels of phrasing), but also accounting for local events (individual notes corresponding to accents) in a systematic way. Here, each accent is modeled by means of two new functions, respectively for timing (duration) and dynamics (sound level) variations in the vicinity ot the accent. When a tone or a chord has more than an accent, profiles in timing and dynamics account for a linear combination of all the accents (according with the mathematical model). Once the accents are marked in the score, the ACCENT-SL and ACCENT-DR rules associate to each of them an arch-like tempo curve and a sound level according to a given parametrization. Each function admits five free parameters: the event peak, the width of the interval preceding the accent, the width of the interval following the accent, the shape of the curve before the peak, and the shape of the curve after the peak. Curves' shapes are linear, quadratic, cubic, exponential, Gaussian, cosine, and hand-gesture (a function using a mathematical model for approximating point-to-point hand gestures [3]. A graphical interface enables the performer to apply these rules by choosing any possible combination of free parameters (see Figure 1).

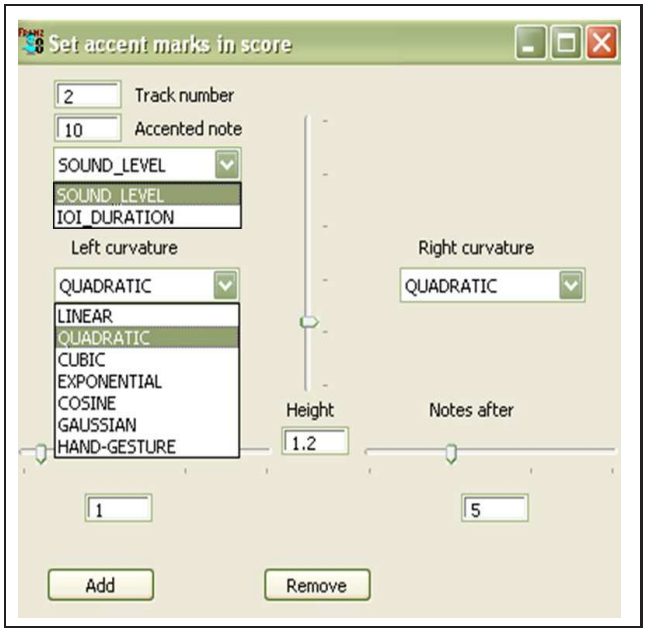

Figure 1. Graphical interface in the accent-based formulation of Director Musices.

2.3 Rendering Method

Our approach to performance rendering involves two separate stages. First, we analyse the score (see for instance Figure 2). The output of the first stage comprises two independent hierarchical structures (for phrasing and metre) and a series of harmonic and melodic accents (considered as local events). For each hierarchical level or accent, we estimate the musical importance or perceptual salience. In the second stage, we adjust timing and dynamics in the vicinity of those accents. The extent of adjustment depends on the salience values.

The phrasing structure can be determined by subdividing the entire piece into 2-3 longer phrases, then dividing each phrase into 2-3 subphrases and so on. Here, we have generated five hierarchical levels (in the whole piece), which are marked in green on the score. The first chord marks the start of a phrase on all the main four hierarchical levels, so it is marked 1 2 3 4. The end of bar 4 is the start of a phrase on the 4th level so it is marked 4. Each phrase also has a climax; in the second stage, the climax is the point at which the instantaneous tempo would be fastest if other hierarchical levels were ignored. Harmonic accents are placed on dissonances or surprising harmonies. Melodic accents are marked at local peaks in the melodic contour or following leaps, e.g. in bars 3, 6, 9, 10, 11. We believe that melodic accents play a particularly important role in musical expression that has often been neglected in psychological studies. The salience of the accents is shown on the score as subscript numbers between 1 (small accent) and 5 (large accent).

In the second stage, timing is slowed and dynamic increased in the vicinity of accents. We used only the rules based on the accent-based formulation. The salience of each accent translates approximately to the area under a curve of nominal tone duration or loudness against time: the longer the time-window, the lower the peak and vice-versa. Our model of phrasing-based timing is less direct than Neil Todd's; we begin by looking at accents within the phrase and apply timing / dynamic curves which are adjusted to start or end at phrase boundaries (just as phrase boundaries have been found in psychological studies to mark chunks of musical memory).

Our system also gives the user the opportunity to manipulate emotional effect by changing the shapes of the curves; options used in the rendering of this piece include quadratic, exponential, and cosine. In this rendering, repetitions of motives with the same structure are modeled by the same set of accents, and expressive variations from one motive to another are accounted by different accents' saliences and curve shapes.

We listened to the midi output from DM on a Yamaha Clavinova CLP-370. The total duration of rendering for the performance is 1 min 18 sec.

3. CONCLUSIONS

Advantages of the new system respect to the old one are: (1) the accent procedure can closely approximate the patterns of timing and dynamics obtained in the phrasing-based formulation, without the need for any other principle; (2) the number of free parameters is reduced; (3) different subphrases can be modeled independently from one another, leading to higher variability in the profiles of timing and dynamics and hence a wider spectrum of performances; (4) accents can be applied differently on different voices.

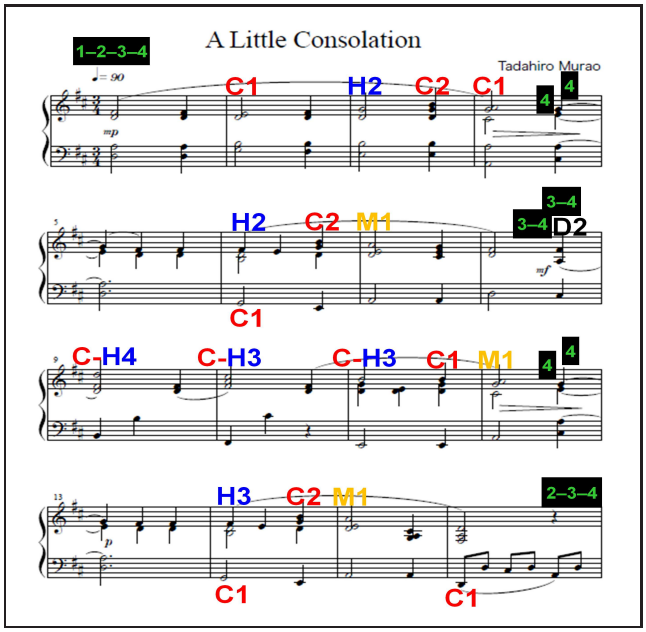

Figure 2. Example of analysis of accents in "A Little Consolation" by Tadahiro Murao (first sixteen bars). Hierarchical phrasing is indicated by numbers in the boxes (upper boxes for phrase start and lower boxes for phrase end); subscripts respectively refer to the main phrase (1), to subphrases (2) and sub-subphrases (3 and 4). Melodic contours, harmonic, metrical and dynamic accents are indicated by letters C, H, M and D and their saliences correspond to subscripts form 1 to 5.

4. REFERENCES

[1] R. Parncutt, "Accents and expression in piano performance," in *Perspektiven und Methoden einer Systemischen Musikwissenshaft (Festschrift Fricke)*, Peter Lang, Frankfurt/Main, Germany, 2003, pp. 163–185.

[2] A. Friberg, R. Bresin, and J. Sundberg, "Overview of the kth rule system for musical performance," in *Advances in Cognitive Psychology, 2 (3)*, 2006, pp. 145–161.

[3] P. Juslin, A. Friberg, and R. Bresin, "Toward a computational model of expression in performance: The germ model," in *Musicae Scientiae special issue*, 2002, pp. 63–122.