Interpretation of everyday gestures – composing with rules

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This paper will suggest how a composer can integrate everyday gestures into a musical composition. The paper will only look at the rhythmical aspects of gestures, and the composer will have to formalize his musical ideas into rules and constraints. The interpretation of gestures into composed, metric rhythm will be discussed. A method for creating an interaction between the composer's personal rhythmical language and the quantification of the gesture will be suggested. The constraints programming paradigm will be used, and a backtracking search will find the metric rhythm.

Introduction

Music notation has been a condition for the development of Western Music as we know it today. Notation has given composers the possibility to understand, plan and analyze complex sound events. A composer realizes his musical vision step by step with the help of notation.

Computer assisted composition usually operates directly on the notation of music. The computer assists the composer to find a notation for a musical vision. The musical vision has to be formalized by the composer. This is typically done with algorithms, but other techniques are becoming more and more common. Since music theory traditionally uses rules to explain music (for example voice leading rules) the increased interest in constraints programming (programming with rules) in the computer music community is not surprising.

Everyday gestures and metric patterns

Musical gestures and phrases have often been explained as originating from gestures in our everyday life, especially from gestures created by the human body. Gestures in our surrounding have also been a source of inspiration for several composers. If an everyday gesture is used in a piece of music with metric rhythm, its course of events has to be forced into a metric pattern. There is not an obvious way to do this, and the choices the composer makes will be his interpretation of the gesture.

Metric rhythm and its notation have several typical qualities. Durations are notated proportionally to each other, and it is accepted that the performer treats chronometric time approximately. This reflects that perceived time and chronometric time are not identical, and time in music is often perceived proportionally.

By grouping rhythm into bars the notation has the possibility to indicate pulse as well as the hierarchic weights of the pulses in music. The experience of metric hierarchy originates in the way our brain groups musical events. Pulse and hierarchy in music might not be perceived by our ears, but still clearly experienced by our brain. Music notation has the potential of indicating psychological aspects of music.

Chronometric time and metric time

If an everyday gesture should be used in a notated composition its course of events first has to be measured in chronometric time. The usual technique used for transferring chronometric time to metric notation is quantification. This can be thought of as a straightforward way of rounding the time values up or down to the closest possible proportional duration. The result will be affected by the tempo, the choice of shortest note value and the use of tuplets in the metric rhythm.

In figure 1a the sound of a passing train has been measured in chronometric time. The graph shows mainly the sound of the wheels beating on the rail. In figure 1b the same sequence has been quantified into proportional notation. The sequence is built of durations from a set of proportional notated time values (the domain) in a given tempo. In the example the durations span from a sixteenth note quintuplet to a whole note.

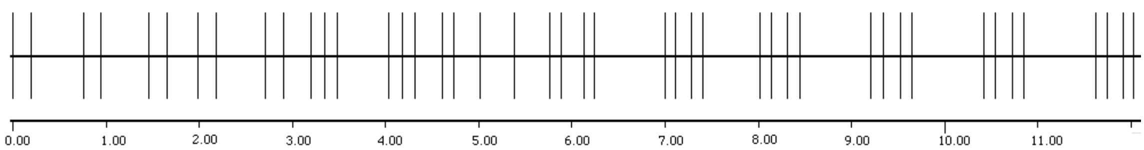

Fig.1a. A chronometric timeline representing the sound events from a passing train.

Fig.1b. The same sequence of events quantified into proportional notation.

A rule controls that the maximum allowed deviation from the chronometric timeline is not exceeded. The maximum deviation in the example is +/- one sixty-fourth note (≈ 24 msec in the given tempo). A heuristic rule makes sure that the notation that gives the smallest deviation is picked. In all the examples in this paper the tempo is set to a quarter note = 157. In this tempo the first duration will exactly correspond to an eight note.

The precision in the quantification process should be judged from a musical perspective. A musician will find the sixty-fourth note precision in the given tempo a high demand. His interpretation of the notated rhythm will probably influence the listeners understanding of the rhythm to such degree that a more accurate quantification (i.e. a smaller deviation) will not make the listeners experience closer to the original gesture.

The concept of pulse has not been taken into account, and the durations are quantified independently of each other. If we try to impose metric hierarchy on the result we will see that this is not done very simple. In figure 2 a 4/4 time signature has been forced on the rhythm in picture 1b. An everyday gesture that is easy to grasp has been notated in a way that is impossible for a musician to easily understand. However, of all examples in this paper this will be the one that is notated closest to the measured chronometric time.

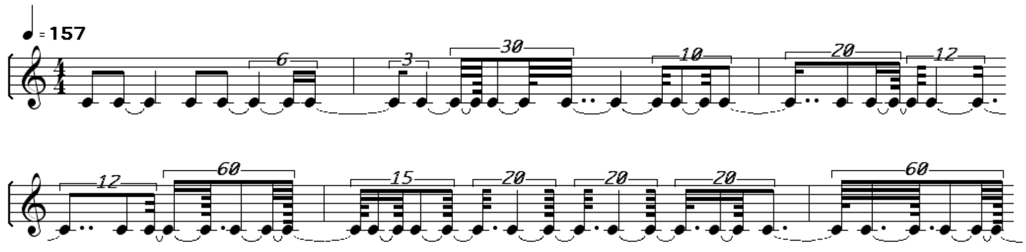

Fig.2. The same sequence as in fig 1b, but forced into a metric framework.

In figure 3a and 3b two notation rules have been added. The purpose is to make sure that the output is readable, but the rules will also affect the accuracy in the process. The computer tries to find time signatures that fit the rhythm. Eight different time signatures are allowed: 4/4 3/4 2/4 6/8 5/8 3/8 2/8 and 1/16. The order in the list reflects the preference for the different time signatures. The first time signature (4/4) is preferred, and the last (1/16) is used only when no other is possible. The first rule defines the allowed subdivision of the beat in a measure. In the example a beat length of a quarter note (time signatures 4/4, 3/4 and 2/4) is allowed to be subdivided into eight notes, eight note triplets or sixteenth notes, and a beat length of a eight note (time signatures 6/8, 5/8, 3/8 and 2/8) is allowed to be subdivided into sixteenth notes or sixteenth notes triplets. This means that triplets are not allowed to start offbeat. Beat lengths of a sixteenth note (the time signature 1/16) are note allowed to be subdivided.

The second rule controls where the first event in every new measure is. In the example the rule accepts the first event to be at the first beat, an eight note after the first beat or a quarter note after the first beat. The two latter cases imply that the measure starts with an event that is slured from the measure before.

The accuracy we require in the proportional notation affects how complex the notation will be. In picture 3a the maximum accepted deviation from chronometric timeline is +/- one thirty-second note triplet (≈ 32 msec in the given tempo) and in picture 3b the maximum deviation is +/- one thirty-second note (≈ 48 msec). We can clearly see how this affects the complexity in the notation. The system is set to prefer simple time signatures to accurate timing.

Fig.3a

Fig.3b.

It can be questioned if the concept of downbeat and upbeat truly exist in the examples in fig.3. The two notation rules described above do not cover the complexity of the problem. Also the choice of pitches for the rhythm will influence the experience of metric hierarchy. The result should be seen as suggestions that the composer has to evaluate.

Composed rhythm and quantification

Composed rhythm has more aspects than can be found in the gesture above. A composer usually works within his own characteristic rhythmical language. A typical approach to create a distinct rhythmical profile is to limit the ways the durations are combined. Composing with recognizable rhythmic motifs does this.

If we change the domain of allowed proportional durations in the example above to become a domain of allowed rhythmic motifs the approach mentioned above could be obtained. Instead of building the sequence from single durations it will be built of pre-composed motifs. It is not allowed to change the order of the durations within a single motif. Since the flexibility of arranging the durations in any order is limited it will be harder (if possible) to find a solution for the quantification. By adding the concept of rhythmical ornamentation the chance of finding a solution increases.

In picture 4a the quantified rhythm has become a framework for rhythmical ornamentations. The quantification rule now allows rhythmical events in between time points in the original gesture (i.e. ornaments). Maximum two ornamental events in a row are allowed in the example, however the number of ornaments is preferred to be as low as possible. In the example all events that coincide with the original gesture are given the pitch middle C.

Fig.4a. The chronometric timeline quantified with rhythmical ornaments included.

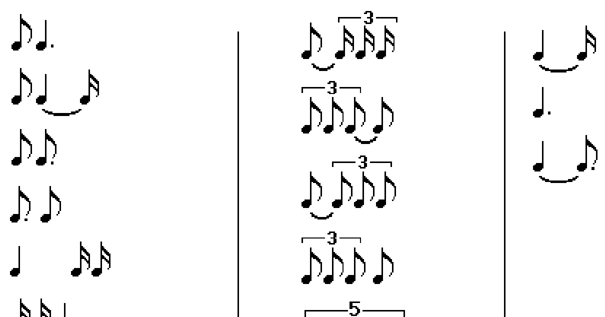

Fig.4b. The motifs and durations used in the above example.

The accuracy in the quantification can be set as before. A very high accuracy might not give a solution. In the example the maximum deviation from the original chronometric time line is set to +/- one thirty-second note. Different solutions can be found if changing the number of allowed ornaments, the degree of simplicity in the notation and the accuracy to the original time line. In the example a low number of ornaments is preferred to high accuracy (however, the maximum deviation can never be exceeded).

The rhythm in the example is built from a set of 11 different motifs supplemented by 3 single durations (see picture 4 b). The motifs were kept short to increase the chance to find a solution.

Other rules can be added to interact with the quantification. Examples of rules that already have been experimented with are counterpoint rules (if more than one voice is calculated) and markov-chain rules.

The implementation

The examples in this paper were calculated with the pmc search engine from the Patch Work program for computer-assisted composition developed by Mikael Laursen. The search engine was extended to handle multi-layered searches (i.e. polyphonic music).

The system was implemented in the Open Music program from IRCAM. This made it possible to develop a graphical interface for building rules. The patch used for the example in figure 4 can be seen in figure 5.

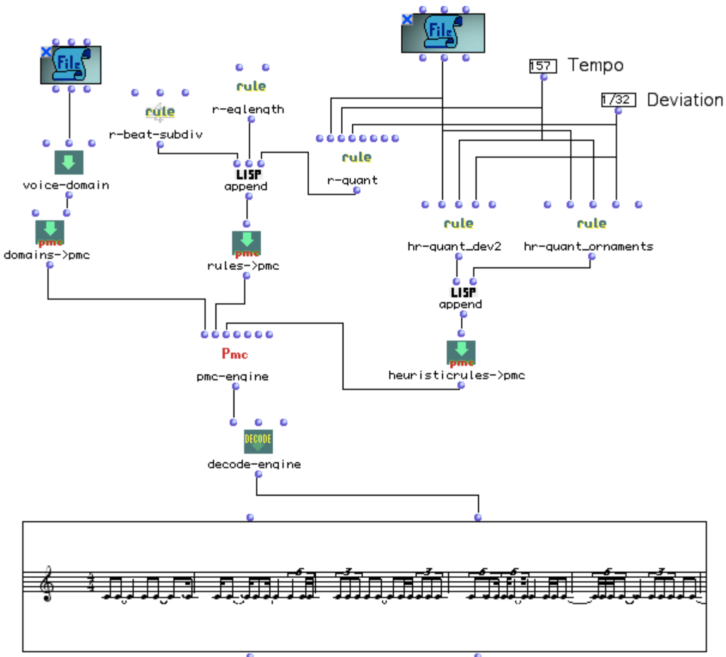

Fig.5. The Open Music patch used to generate the example in fig.4.

Conclusion

If a composer uses an everyday gesture as a starting point for his composed rhythm, he will have to force the gesture into music notation. It is possible to let aspects of the composer's rhythmical language influence and interact with the quantification process. A rule-based system will allow the composer to add other structural ideas to affect the quantification.

Future development includes letting pitch structure influence the process.

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