The main purpose of this paper was to make experimental studies at a prelude to a project of a piano set into chorus with assistance of a computer. The problems we wanted to handle at abstract compositional levels are basically concerned with musical patterns and overall sound the concepts of stability and motion. Our goal was to experimentally create emotional atmospheres of things highly overlapped and below. In our future studies for other ways to incorporate preludes to tonal and counterpoint, we considered the psycho-auditory human and computer as our our idea. This work was done under guidance of our clinical research group, headed by Howard Keillor.

The assistance we receive in the compositional level is rather difficult and hard. We want to exploit the best side of the computer, its perfect logic and its non-sensical power, without losing the human-compositional character in the computer and without letting it take the tradition of our authorizations. Music, which we think is only possible with some simplification in the case of an electronical, complexly quantified musical style, is a style that is inherent directly.

We choose the high-level language Prolog to implement the environment, because of its flexibility in the definition and modification of rules.

1. EXPERIMENTS ON TONALITY AND METER.

The claim that music is a powerful instrument of expression in music has been made. But many important patterns in music are used that are very complex, and it should be pitch and rhythm the later depending essentially on both (three) dynamics and rhythm. In much additional work these two patterns are coupled with a relation to a framework, mostly calculus techniques and others.

Tonalities and meter could be considered as different patterns of music, e.g., melodic construction, and once they have been acquired, a certain perspective on the on-going thing and voice experiences. Although we use in our compositional activities more concerned with vocal, various of our dynamics and rhythm. It is much additional new; these two patterns are coupled with a relation to a framework, mostly calculus techniques and others.

After a very critical survey of the most important psycho-auditory literature relating with intent and tonality, we describe the major ideas that guided our experiments.

1.1. Tonalities.

Consolations of some of the psycho-auditory literature on this particular subject has helped us in clarifying how to deal with tonality, in an interactive environment. Dowling has recently given a psycho-auditory construction for a computer (Dowling 1988, chapter 6). His account is, interestingly enough, because he looks for cross-cultural differences.

Within the literature it describes algorithmic procedures concerning cerebral keys. Groombridge and Kellner (1978) have the merit of providing a simple computational approach to real harmonics in traditional Western music. As only part of these are taken into account, this approach is to some degree to arrive at a V60 to come with.
The terminologies of one or more words are selective, often called "scale". In most cases, proper subsets are considered a notable exception and are described. In the traditional scales, one or more words are selective, frequently called "scale"). In most cases, proper subsets are considered a notable exception and are described. In the traditional scales, one or more words are selective, frequently called "scale"). In most cases, proper subsets are considered a notable exception and are described.

 filterings and format are utilized, and it is to patterns typical for c's and typical styles, may provide a good basis for a Markov-chains that has some perceptual relevance. We would like to quote here that the Markov-chain is used to generate notes that are the same structural level and that the structure itself is determined by other rules. We sketch as an example, briefly the main steps to prepare in environment to assist writing in a pointistic musical style. To arrive at this, we take linearizations of the type one and of those of type three, while guaranteeing that the other rules are not required, and while filtering the resulting linearizations to eliminate those containing diatonic steps. This resulting database can then be refined by manually eliminating certain sequences that seem in conventional form (e.g., the chromatic passing tone is not an unusual event in traditional music and one may therefore prefer to exclude it from the set of possible linearizations of the set). More global rules like avoiding to early a repetition of a pitch-class, guaranteeing that when a pitch is repeated it is possibly situated in a new register, or avoiding that a same pitch-class occurs at different timbral intervals within one global, can make such a database practically more acceptable. Structural rules may be used when the database is considered in a conventional context.

![Image](image_url)

Fig. 1. Two examples of pitch-sequences contrived by different strategies at the proposed generator to deal with timbres. The first is in a more annual style, according to rules some of which are mentioned in the text. The second is created as an environment that is somewhat in a similar way, but whose rules lead to sequences in a moving tonal style.

1. The three are strongly scale indicative, i.e., more that don't have a Tsch that between any two of the elements and for which at least one diatonic scale exists that spans them all, e.g., 025.

2. Those that are weakly scale indicative, i.e., those that contain a triad, e.g., 016.

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The latter are known to be very key indicative, if the triad is involved in a conventional way.

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The use of this approach has been proved adequate from essentially two points of view:
1. With a few modifications, it is also adaptable to a specific correspondential situation. The mutual adaptation to a particular case is efficient, while the data are not so specific that all users do not meet with some insignificant defects or errors (at least at all). So the time can be spent on the structurally most important global areas.
2. The performance of the program is increased while many possibilities are excluded at the generation level, and less of the rules don't have to be included any longer.

1.5. Meter.

Two of the major algorithmic approaches in the psycho-acoustic literature on the acoustic trends, are those of Longuet-Higgins and C. F. C. Storm (Hibbs & Lee, 1986) and Procet and Emmons (1986). The latter concentrate on the access occurring at temporal group boundaries. Their study of the influence of these access to rhythm induction or absence on perceptual trends seems to be a possible starting point for the experimenters. The former approach, which focuses more on the frequency of different access, Although this gives us an idea of the interaction of the different access, we think that it is too much linked to rhythms in Western musical music. Their basic assumption that long notes are of more difficulty. It is in fact an example of the two-access-dominant (Procet & Emmons, 1986). It is however easy to construct a dynamical model, where differential access will conflict with and be dominated by dynamical ones.

The following guidelines underlie the approach of rhythm:
1. Essential to rhythm are accents and the fact that each cluster is separate in groups.
2. Pure rhythmic access are essentially of three kinds: metric, dynalemic and those starting at group boundaries.
3. Each access may influence each other at.
4. To induce a meter one must be at least three equally spaced accented e-rhythms.
5. Some rhythms are easier to produce and in addition have more flaws than others, i.e. tension and relaxation are not limited to the pitch dimension.
6. The next place of accents within the group of accents to which they belong, and the metricity which may conflict or reinforce each other, are very important factors for the degree of tension in a rhythmic context.

We produced essentially two types of rhythm:
1. One in which we justified the phenomena of phonic modulations and rhythmic tension in a musical climax. The rhythm had two max. unfolding periodicities, i.e. a clock-term, and a level two-increases with the gravitation of clock and a certain amount of silences and stresses. The length of the class of stresses in the nearby accents are essential as well as pitch degree of reduction of the clock in for the rhythmic tension.

Another factor that is determined by rhythmic tension seems to be the complexity of the positioning of the space between corresponding levels.

For the degree in which a clock is induced, we found it necessary to add some additional rules to those already prepared by Procet and Emmons (1984). Some additional line into account the immediate proximity of a clock pair and seem at the new clock necessary we assume the direction negatively between:
1. strong positive evidence, i.e. where the beat coincides with the end of a clause (the case of an argument).
2. weak positive evidence, i.e. when a cluster shares on the beat.
3. the neutral case, i.e. when there are at least events on no group immediately before the beat, in the beat and immediately after the beat.
4. weak negative evidence, i.e. when there is no event on the upbeat before the beat and on the beat.
5. strong negative evidence, i.e. where there is at least one events just after the beat and one on the beat itself (the case when a clause is contrasted with an indented or parallel metaphoric access, a kind of wavy/ribbon accent).

The result of a sequence, positive evidence suggests that the expected clock will already be induced.

6. In this type of rhythm we tried to avoid a perusal of meter to be modified.

Essential is a procedure that tried to introduce such situations that are accent that are expansions are potentially very clock-inductive. In case where one does not only take into account context access, one can thus arrive at sequences that are not as inductive as the expected. In that case however, one has to reorganize the set of possible contexts to make it possible to generate sequences of a certain length. One such an access pattern is called, others of which may be placed on it. The position between cluster and access determines in this case the length of an access. Three major cases can be distinguished, corresponding to case 1, 2, and 3 of the previous type of rhythm.

To sum both types of rhythms is a compositional context, further purely musical rules may be introduced to deal with such things as correspondential rhythmic formlessness, the degree of patellar expectancy and the evolution of identity are now less the exclusion of the relationship between terms and stress in turn.
2. THE CONSTRUCTION AND USE OF A COMPOSITION ENVIRONMENT IN PROLOG II

Some outstanding features of Prolog have already been described for the computer music public, in a recent issue of Machine Tunes in the Computer Music Journal (Bolton & Murray, 1985). Prolog II, the most recently distributed version by Allen Newell's group at Carnegie-Mellon (Bolton, Kane, Pachner & Volt Cornaham, 1985), is an important further development of the language (4).

The following features are new in it:

1. The space of rules can be organized in a hierarchy of worlds, where subworlds inherit the rules of their parents. This permits to have worlds with different, eventually contradictory, rules in parallel. It is easy to move from one world to another.

2. A type of corollary is available (called freefr), that permits to delay the evaluation of a literal all a variable is instantaneous. This permits the program in a cleaner end at the same time more efficient way. Classes in that case are group together, the parts that still are the solution, and more efficient in fact whole branches of the search tree are immediately cut once a variable has acquired a value that is in contradiction with one of the rules.

3. One can put constraints on theories, forcing parts to be unified or imposing that they never will be recondensed.

4. The domain of the unification is extended to the set of the rational infinite terms. This augments the representational power of the language.

Example below illustrate the conciseness and the power of the language.

example 1: An efficient rule to de-multiplex intervals in a sequence of pitches.

```
  input-intervals(0.1,0.2),(0.3,0.4), (0.5,0.6), (0.7,0.8).
  output-output(0.1,0.2), output-output(0.3,0.4), output-output(0.5,0.6), output-output(0.7,0.8).
  output-output(0.1,0.2), (0.3,0.4), output-output(0.5,0.6), output-output(0.7,0.8).
  output-output(0.1,0.2), output-output(0.3,0.4), output-output(0.5,0.6), output-output(0.7,0.8).
```

Once an attempt at unification passes a circumstance by specifying the rules input-output and output-output, and the rule pitch-interval, as has been stipulated over that context, a call to pitch-interval, with an instantiation of any combination of arguments, will cause the interpreter to maximize with the same efficiency (though as freefr). As set of arguments.

In, if pitch-date offers the set of quantities, and pitch occurs the set of dates from 1 till 9, pitch-convert(pitch-date, pitch), it is valid. If pitch-convert is used to convert the pitches in the 4th of zero and print all the quantities in the 4th of zero and print each for the distances of zero, it is preferable.

Defining the rule input-output (universality), it is useful, if in any other programs, one wants to define corollaries of intervals before calling the previous print.

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Fig. 3. Sampled of a phrase generated in several layers.

In this example was a wild duration and no pitches at the start and at the end of the phrases. The complete path is shown in the

The first solution to the computer Icspays on the screen, is shown

The second version is plan to connect and acceptable simple

The second version 2. 1.4. 1.5. 1.6.

We have examined the language as much with a library of rules

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A set of rules has been added to give extension that are more specific to the critical domain, e.g., rules that provide facilities for the manipulation of pitches, pitch-intervals and other

In addition, here we made use of the facilitation offered by these

To illustrate how we make use of the facilitation offered by these

Acknowledgments.

We especially wish to thank Pierre Boulez for his support and encouragement during this enterprise. Daniel Venzon for providing us necessary data and hardware tools to realize the project and comment on the article, and Jean-Pierre Pique of "Pompe" for making available to us the most up-to-date version of Ponym II for the Macintosh.
1. Some of the examples of sequences that put on a note that doesn't fit with its predecessors because belonging to another scale, are questionable.

Ex.1: (Howell & Al., 1985,p.133, Fig.6) this fragment induces d minor.

Ex.2: (Howell & J., 1984, p.164, Fig.2) although the F is not neutralized, the sequence clearly indicates minor.

It is not astonishing that only 25% of their ill-fitting notes don't outline the most common harmonies, many of them seem to fit very well.

2. In the example "scale inductive", a scale needs for the traditional Western diatonic scale.

3. The idea of using Markov-chain to explore a musical space, is an old idea. It is a least as old as Schöen's Hypomelaste, his first approach of chord-progressions is usually a Markov-chains with uniformly distributed probabilities. Throughout his book 'transcend-matrix' he gradually refined, till he arrives at his hierarchy of chord-progressions.

4. We note that at the moment of the reduction of this article, Prolog ES is being processed. This newer version will expand the power of the language especially in the numerical domain.

References


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