A Computer-Assisted Version of Stockhausen's "Solo for a Melody Instrument with Feedback"

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Solo for a Melody Instrument with Feedback was composed in March and April 1966 for a commission from the Japanese Radio Broadcasting Services. The piece belongs to a period in which Karlheinz Stockhausen was using microphones, filters, sine wave generators, and ring modulators as real-time instruments for live electronic music. In *Solo*, he turned his attention to the tape recorder—or, more precisely, to the tape loop. For Stockhausen, feedback went beyond the simple "reinjection" of sound into a musical process; it had a more general meaning, as he himself said: "I mean, for example, any kind of feedback between musicians who play in a group, where one musician inserts something, bringing something into context and then listening to what the next musician's doing with it when he's following certain instructions, transforming what he hears" (Cott 1973).

Other pieces written with this philosophy include *Prozession*, *Kurzwellen*, *Spiral*, *Pole*, and *Expo*. The composer used different symbols to indicate the transformations to be used with a chosen musical event played by either the same or another player.

Always interested in the expanded technical possibilities of melodic instruments, Stockhausen wanted to compose polyphonic music for a solo monodic instrument where the soloist is aided by several assistants (Stockhausen 1971):

> I imagined a music in which—as in life—fragments and forms of memory audibly superimpose *simultaneously* in certain moments. The soloist could play commentaries, amplifications, and new material over it. A music wherein one feels the musician "thinking out loud" and one can experience the creation and the disappearance of multilevel processes. Only then, when music makes conscious multidimensional thinking and experiencing and the *process of structure-forming* instead of an object is a higher level of composition for a soloist achieved. Everything that the instrumentalist "thinks" during the preparation and the execution of his solo should be perceptible in sound: the *feedback* between the soloist—what he already has played, and what he is going to play—between him, his second self, his third self, and his multiple selves, which have already played and which are going to play.

The musician preparing *Solo* first chooses a *form scheme*. The score consists of six form schemes, which provide all information on the structure of the piece, the delay length, the number of cycles, the recording, feedback, and playback parameters, and interpretation instructions. In Figure 1, the six versions of *Solo* are shown with their primary characteristics.

Each version is composed of six periods labeled A to F, and each has a different number of cycles with a predetermined delay. Durations of the delays vary from 6–45.6 sec. Originally, a line of music is recorded on one or both tracks of a two-channel tape, according to the given scheme. An assistant must follow it precisely and monitor the recording levels. A similar task is given to a second assistant in the feedback scheme, and a third assistant is responsible for the playback levels. A fourth assistant controls the switching of

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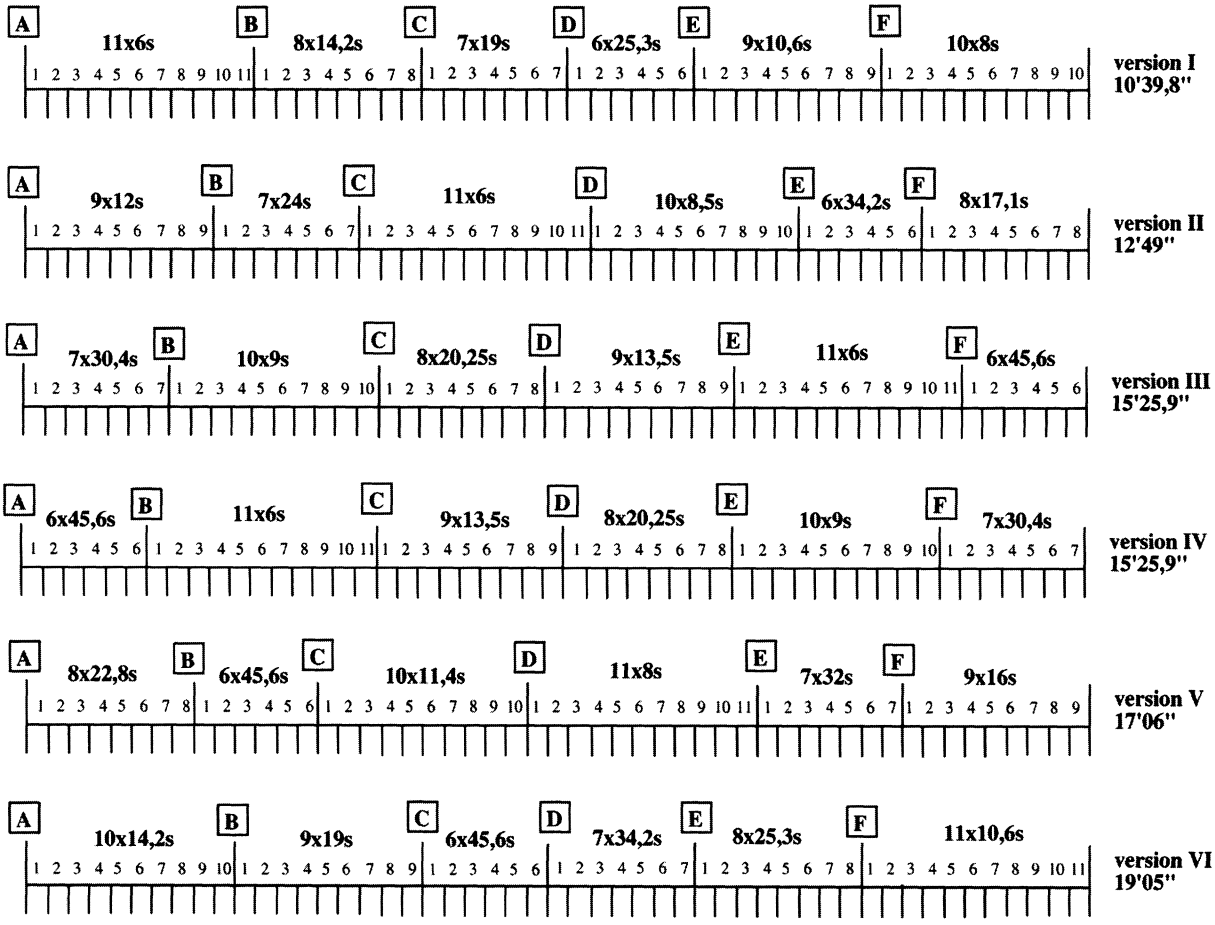
Figure 1. The six versions of Solo *with their primary characteristics: cycles, periods, different delays, and overall durations.*



the playback heads (thereby determining the delay durations), and gives signals at the beginning of every cycle and period to the soloist and the other assistants. All of these tasks are completely mechanical and must be very precise and synchronized. Figure 2 illustrates one section of version V (Stockhausen 1969a).

The technical setup for the delay must be custom made. It includes six stereo playback heads and a means to vary the distances the tape travels between the different heads, as shown in Figure 3. The relatively low accuracy and fidelity provided by the analog equipment is far from what the piece requires. The composer has suggested the use of low-pass filters to compensate for accumulated tape noise (Stockhausen 1969a).

Stockhausen's *Solo* is a piece with an open form (Frisius 1996):

> [T]he live electronic composition *Solo* has a special and important meaning. The variable note material and the technical ways for execution put before the player extremely difficult tasks so that a reasonable interpretation is still an actual challenge today, thirty years after the first performance.
>
> The player must construct the entire composition from its parts, and when performing his *Solo*, he must integrate in a complex polyphonic form process which is available through a variable delay system.

Figure 2. A section of version V with the tasks of the three assistants and the interpretation scheme.

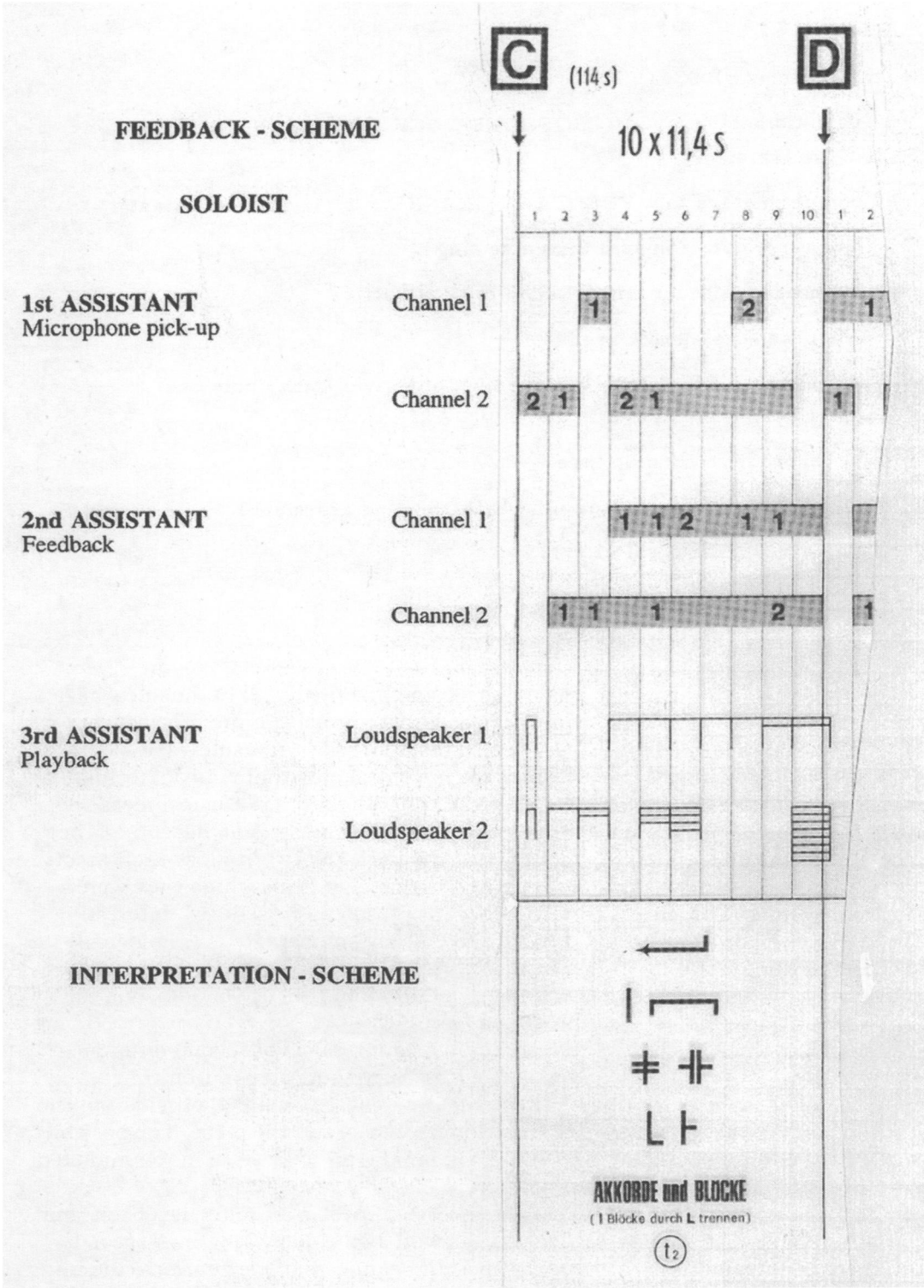
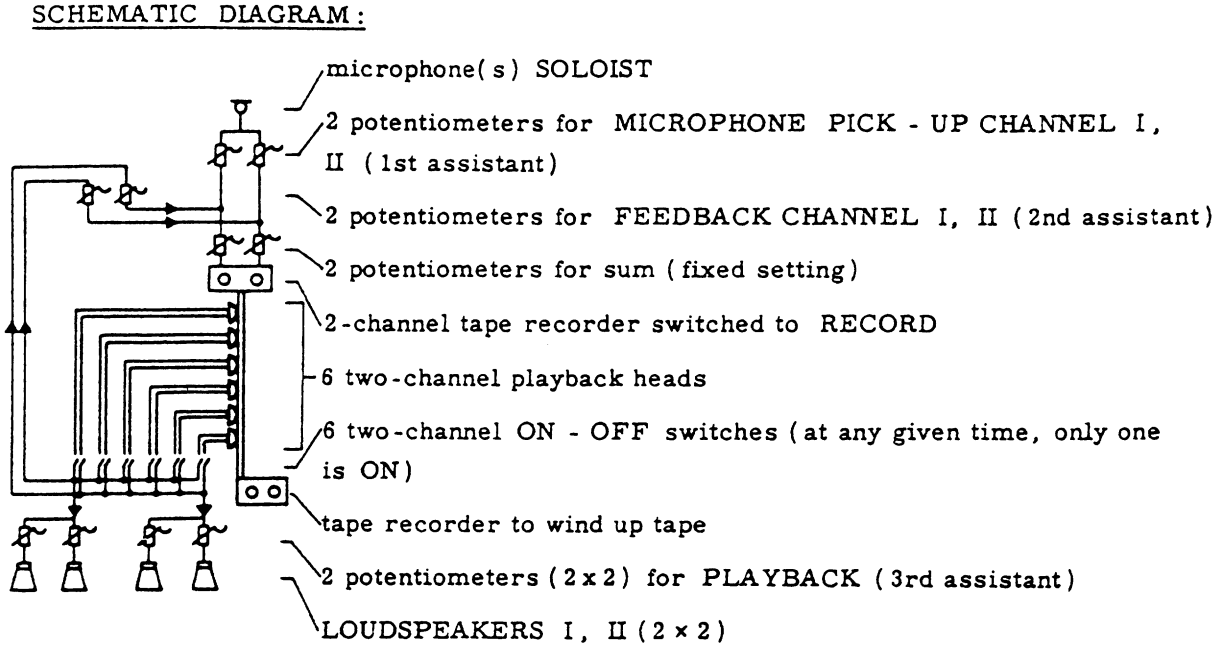


Figure 3. Schematic diagram of the feedback circuit. The sound is picked up by the microphones, fed back after a delay, and synchronized with new sounds.



In 1988, I proposed performing *Solo* using a computer to achieve better results. At that time, it was difficult to work out the delay system required for the piece. At the end of 1992, a version using Max on the NeXT-computer-based IRCAM's SIM (sound processing unit) was prepared in collaboration with Cort Lippe, and was successfully performed in public concerts in February and March, 1993.

Recent technological advances in the computer world suggested the adaptation of the program to commercially available equipment for performances in March 1998. The actual program currently in use is written in MSP on an Apple Macintosh G3, and was prepared at IRCAM in collaboration with Carl Harrison-Faia.

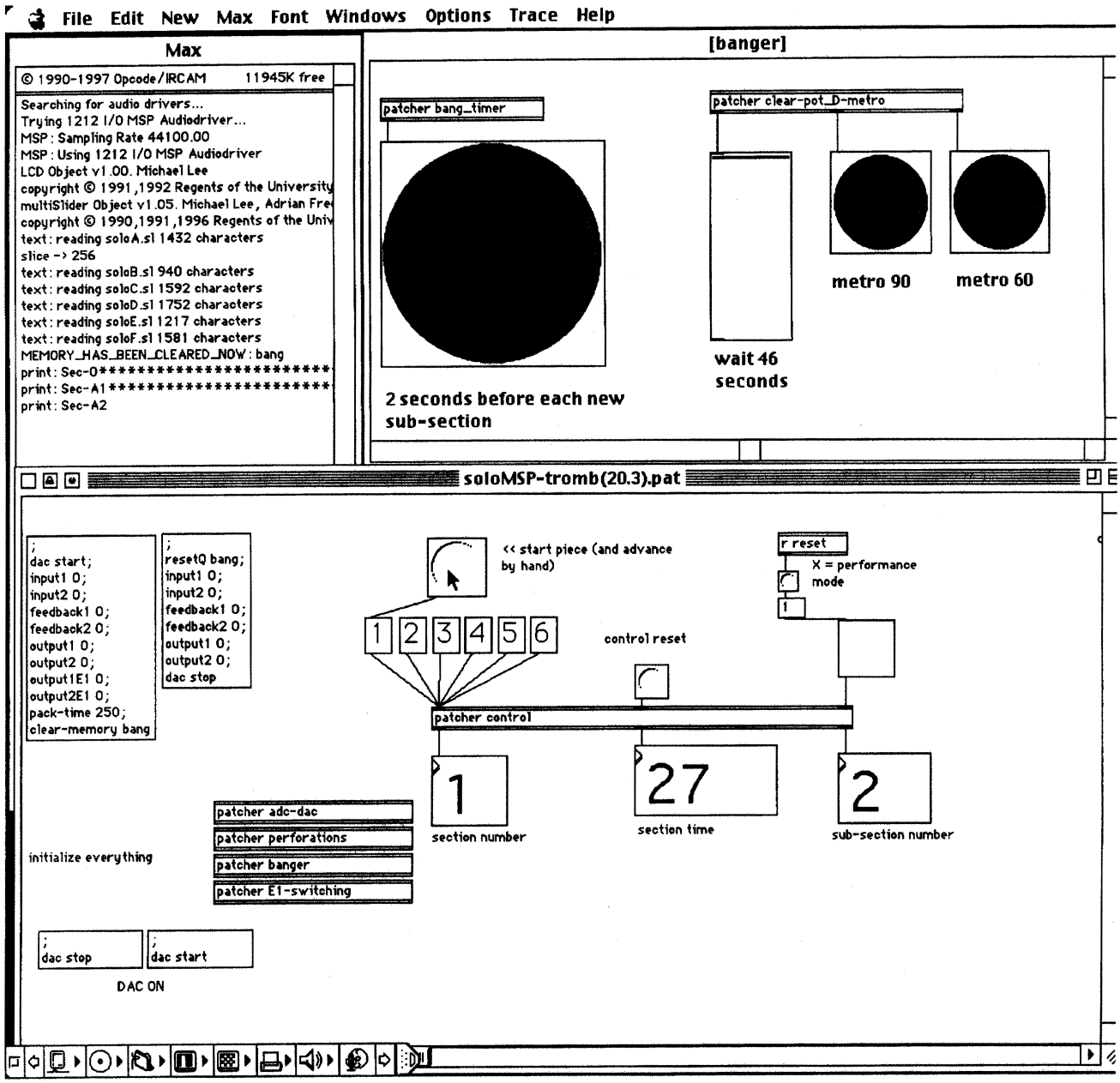
In our setup, the computer produces the delays, performs and coordinates the tasks of the four assistants (notated precisely by the composer), and gives the player an easy-to-use interface. The synchronization required in the piece is thus greatly simplified. The computer also handles the sound transformations. Because there is only one assistant necessary for the sound control in the performance space and practically all of the tasks have now been preprogrammed, a more musical context between soloist and assistant can evolve.

Since the advent of electronic music, technology has progressed so quickly that musical ideas are often left behind. Pieces like *Solo* depend on the technology involved, and tend to lose their practicality when the machines for which they were written become obsolete. It is always interesting therefore to employ an upgraded technological means to perform pieces written with an earlier technology in mind. In the case of *Solo*, one can propose a "global version" of the piece, permitting the successive performance of several different versions with a very short preparation time.

The main window (see Figure 4) provides all the information needed to run the piece. The possibility of rehearsing the piece starting in the middle or at a different tempo is also given.

An events list controls recording, feedback, and playback, as well as the delay length. A special module permits a process of *perforation*—the interruption of the recording, the feedback, and the

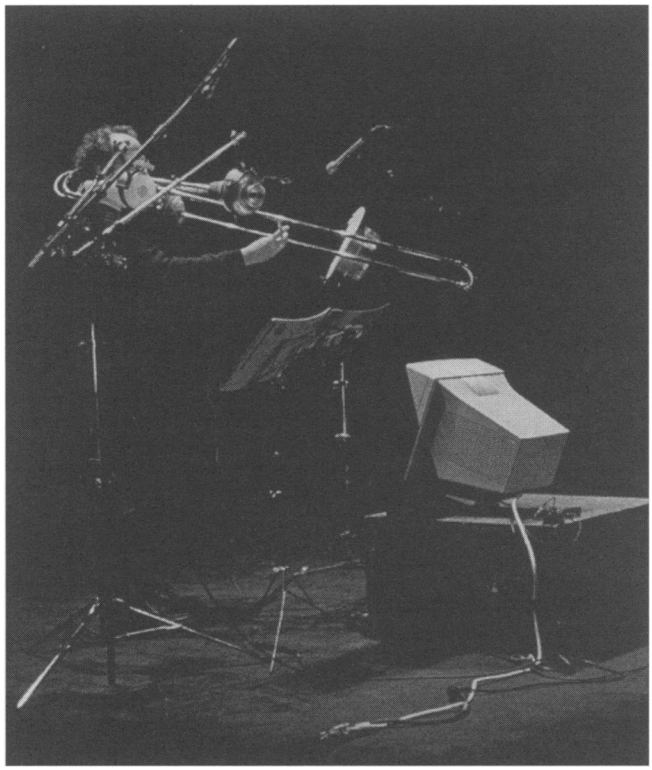
Figure 4. Main window of MSP on an Apple Macintosh G3 computer providing all the information needed to run the piece.



output several times (indicated by a number in the scheme) during a given cycle. This is the only musical task given to the system. (In the score, the assistants were to listen carefully to the soloist and to interrupt the solo line a given number of times in a cycle.)

Four different timbres are prescribed in the score: N (normal), I, II, and III. Arrows between these symbols indicate continuous transitions between timbres. The particular timbres are to be determined by the instrumentalist. Different timbres may also be achieved through electronic means

Figure 5. A performance of an acoustical version form-scheme V. (Photograph by Myr Muratet.)



(filters, modulators, etc.). For an oboe version (form scheme II), we let N represent the unprocessed oboe, I a ring-modulated oboe, II a filtered oboe, and III a harmonized oboe. A trombone version (form scheme V) was constructed with mutes by allowing I refer to a wa-wa mute, II a straight mute, and III a hat mute. The fast changes of timbres required could be achieved with the help of a mute stand (see Figure 5).

The MSP patches were designed to fulfill the composer's indications to the most minute detail. Digital signal-processing units replace the analog tape heads. Real-time transformations can be freely chosen, and are limited only by the computer's available memory and processing power.

The user interface is designed to give all the necessary information for the player: time elapsed in the current cycle, the number of the period and cycle, and a metronome when needed. The player can thus be more precise within the time allocated to each period. The fidelity and precision of this computer-based version permit a performance that is closer to the composer's original feedback concept. A succession of different versions (form schemes) is now also possible.

The composer's position toward the technological part of the realization has been favorable. In fact, both recorded versions of the piece (Stockhausen 1995, 1969b) were not performed in real time. In the first recording, the electronic tape of his *Hymnen* was mixed with *Solo* to compensate for "the strong impression of tension which is provoked by the procedure of the soloist reacting to itself [...] and the lack of the atmosphere created by the audience in a live performance" (Stockhausen 1969b, liner notes).

Preparing the Score

There are six pages of musical notes. One must determine an order and assign a cycle to each page. Composing the part for each section is done by the interpretation scheme (as shown in the bottom part of Figure 2) indicating how the whole page is to be interpreted and how the systems in each page, measures in each system, and individual elements in each measure are to be interpreted (similarity, difference, opposition, or combinations of these). The interpretation scheme also determines the duration of the pauses (long, medium, short, or combinations), as well as the characteristic structure of the superimposition (polyphonic, chordal, or block-like).

The interpretation scheme, together with the layer structure, gives enough information regarding how the page should be composed. As an example, see the original note page (see Figure 6) and the corresponding page C (see Figure 7) in version V realized for trombone by Barry Anderson. One might consider using the computer at this point of the preparation of the score for choosing and rearranging the elements, measures, and lines of music according to the composer's indications.

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Figure 6. Original page of score (©1969 Universal Edition AG Wien Reprinted with permission). The solo part is to be composed of elements, measures, and systems taken from it with respect to the composer's interpretation scheme.

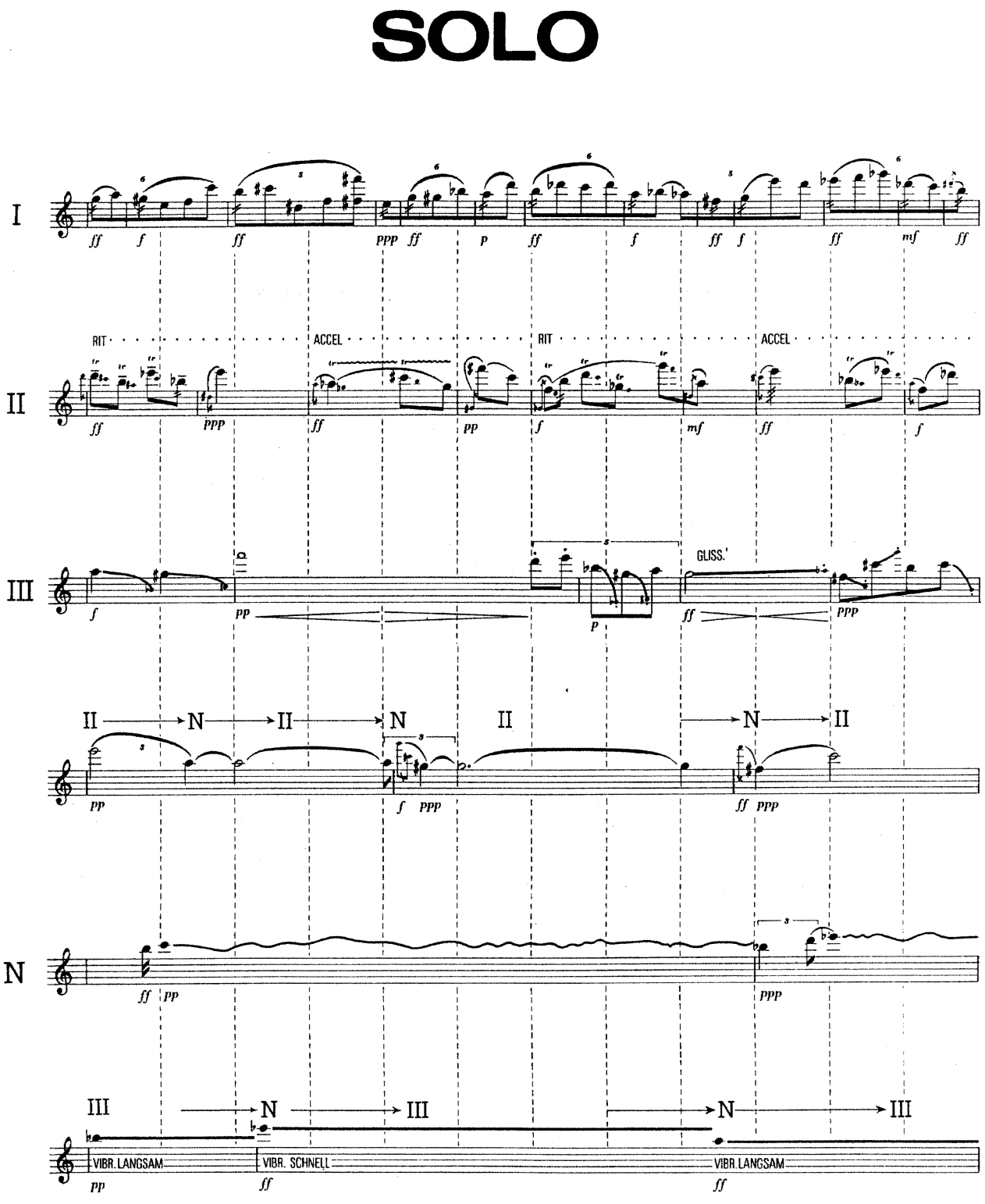
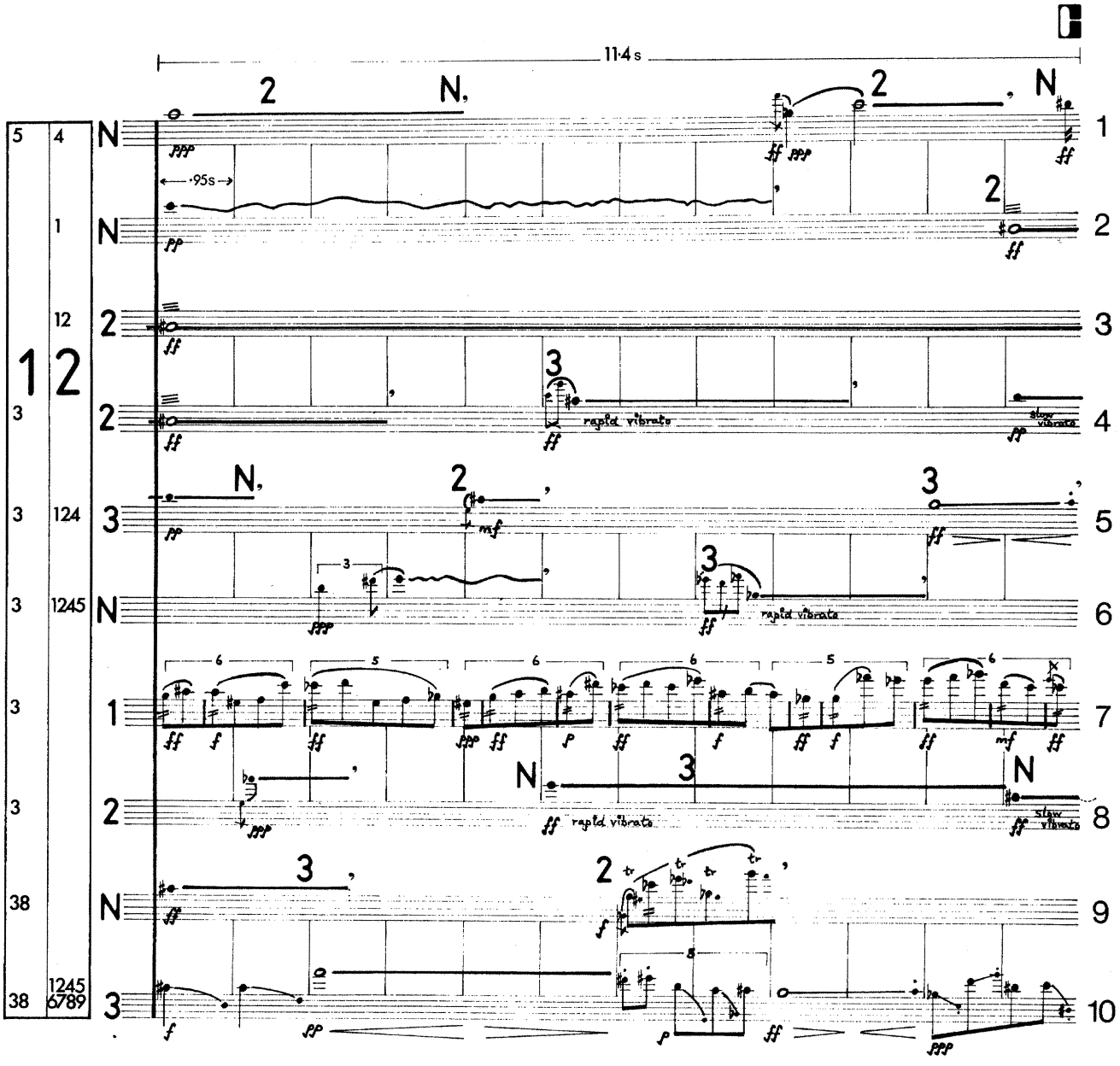


Figure 7. Page C in version V realized for trombone by Barry Anderson, based on the original page of score shown in Figure 6. Each line is played in the duration determined by the particular delay (here, 11.4 sec).



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