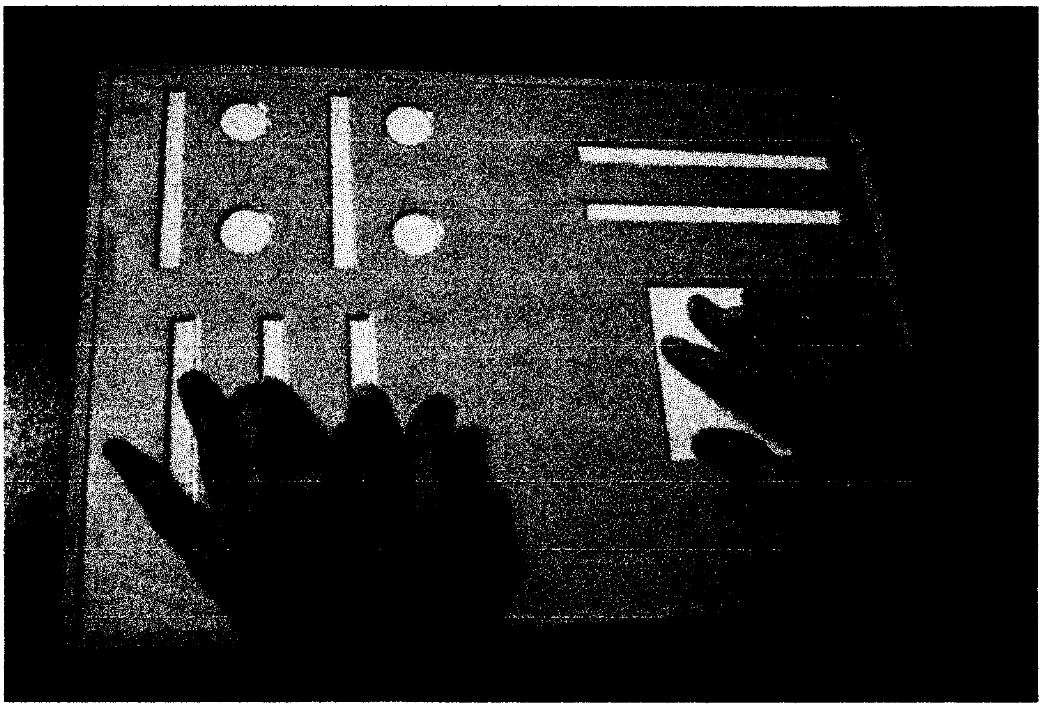
STRATIFIER

**a multi-dimensional controller
for the performance of
live electro-acoustic music**



GENERAL

The **"stratifier"** is new multi-dimensional (sixteen continuous outputs) musical instrument which enables the user to control many aspects of the signal processing and synthesizing capabillities of the computer in realtime, making it a genuime performance tool for concerts.
It was created by *Arie van Schutterhoef* and built in collaboration with the hard- & software designer *Pieter Suurmond* and the sculptor/ instrument builder *Hans van Koolwijk.*
Support was given by **Het Fonds voor de Podiumkunsten**, as part of their grant for the realisation of *"The Day"*, an event which consists of an integrated performance with sound sculptures, live electronics and musicians.

NAME

The name stratifier comes from stratification, meaning shaping things into layers, like the huge amount of data needed to control the different aspects of granular synthesis or physical modelling.
But it is also inspired by the type of violin Paganini played: a *Stradivarius.* Maybe more appropriate because of the connection with live electronics: the guitar of Jimi Hendrix was a *Fender Stratocaster*
and his use of effect pedals and feedback were regarded as shattering experieces.

Both were virtuoso in their own right and took the development of the instruments they played a step further. Hendrix probably into outer space..

AIMS
The needs and reasons for the realisation of the stratifier are described in the following two quotes:

"Analog instruments carry out their operations instantaneously. What they may lack in precision, they compensate for in directness of use: turning a knob affects the sound directly, and one has a tactile relationship with the sound, not so intimately as would be the case with a violin or a clarinet, to be sure, but using analog instruments it is certainly possible to impose physical gesture on electroacoustic sound."
-Gerald Bennett 1990 (1).

"...while sound synthesis systems are controlled through other or more parameters than were available on traditional physical musical instruments, such gestural interfaces do not allow for real-time control during performances of all of these parameters. Instead, these parameters have been explored in great detail with simple functions as well as by using complex, even chaotic, functions in non-real-time situations, i.e. the studio. However, whatever the complexity of these functions, a human most likely will be able to produce more complex or abstract functions through movements in real-time as a result of complex inner processes."
-Axel Mulder 1994 (2).

ROOTS
The origin of the stratifier finds its way back to the period when electronic music was still considered to be created in technological laboratories or university-studio's with an impressive array of equipment and a wealth of resources.
Live electronic music could be imagined, but hardly realised. Some attempts were made with the development of voltage controlled equipment, although the general inflexibillity made the performance of music with these instruments a futile attempt. Also the attachment of a piano-like keyboard severely reduced the possibillities and changed it into a souped-up organ.

Other routes were taken by people who thought that the solution lay in the direct manual control of elements that constituted the electronic studio. Two important events took place during the end of the seventies and at the beginning of the eighties:

1.	The development of the **Crackle synthesizer** by Michel Waisvisz at STEIM in Amsterdam;
2.	The introduction of the **Big Briar 330 touch-plate** by Robert Moog, to be used in connection with analog modular systems.

Their significance lay in the difference in control options that these instruments offer. The multiplicity of separate surfaces on the Crackle synthesizer versus the continuous x-y coordinates at the Big Briar touch-plate.

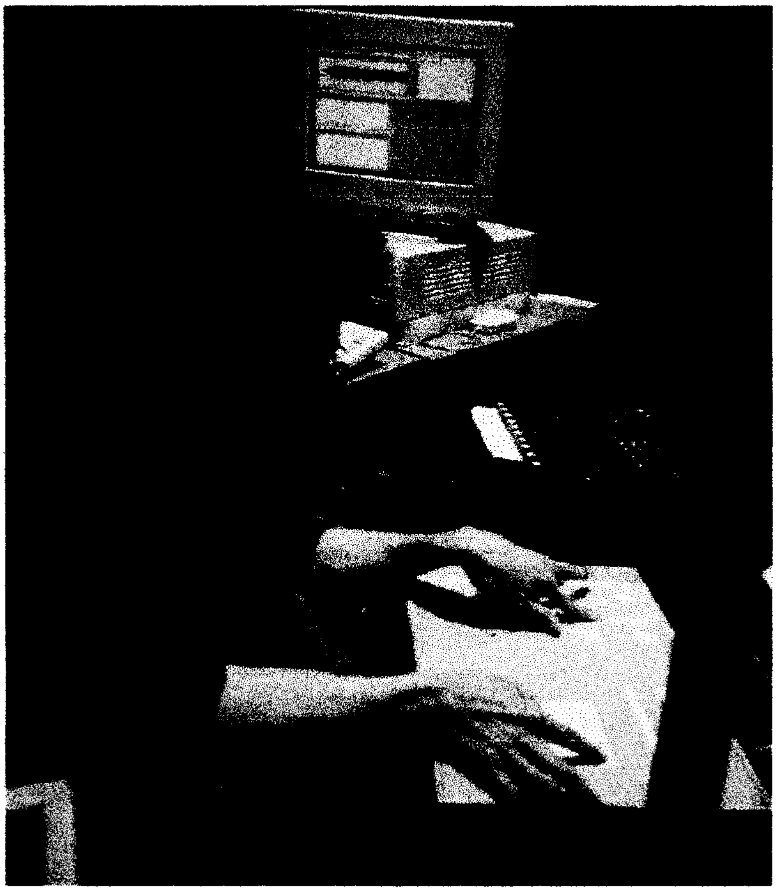
DESIGN
A serious start with the design of the stratifier was made during the summer of 1997, when the different tactile qualities of the Crackle synthesizer and the Big Briar touch plate were moulded together into several

drawings and sketches and each separate instrument started to loose its own identity. The subsequent result was that a new instrument occurred which had little or no resemblance to its inspirational predecessors.

The multiple touch pads on the Crackle synthesizer were reduced to five slider-like sensors and four square buttons, thus reducing the original twenty-one surfaces (on the Crackle) to nine (on the stratifier).
The x-y pad of the Big Briar was of a far more general design and could therefore be more easily integrated, also because x-y pads are used for the control of electronic equipment in factories and heavy industry.

The next step was taking into consideration what all these sensors had to do, what their role was, how their outputs were to be applied. This can be best explained in what kind of way their originators (the Crackle and Big Briar) were used.

During the early Eighties I tried to configure a live electronic music set-up that could be used for both sound synthesis and signal processing. The intention was to make it as flexible as possible, but also very controllable. Decisions had to be taken what was flexible and and free, and what should remain stable/global. As such the sound synthesis part came from the Crackle with its ability to come up with instantenously changing sounds and the Big Briar was connected to a Synton 3000 analog modular system, which had extensive filtering and modulating facilities.



Arie van Schutterhoef playing the Stratifier during the performance of 'The Day', using SuperCollider as shown on the screen in the background.

DESCRIPTION

The stratifier is a multi-dimensional controller, which combines a x-y-z pad, five touch sensitive sliders (scanning position and pressure) and four pressure-surfaces, plus two sliders which respond to position placement and serve as default pads.
The scanning is done by FSR strips with additional hardware (see description below) and subsequently send to **STEIM's SensorLab**, outputting the necessary MIDI-information to a Power Macintosh running **SuperCollider**.

The electronics (designed by Schreck's hardware-builder and software-developer Pieter Suurmond) are housed in a white bamboo-casing, measuring 42 cm width, 30 cm deep and 6 cm high. It was designed specifically to the wishes of the creator and built by the sculptor/instrument builder **Hans van Koolwijk**. The FSR-strips are covered and protected by sheep-skin leather. An important reason for using these organic materials was that is should "feel" and "look" like a "real" instrument
-similar to a violin or a clarinet-, rather than like an electric appliance like a drill or a chain-saw...

These combinations of materials offer a subtle and tactile control, allowing the user to play with delicate finger movements creating intricate timbral fluctuations, but also large scale changes resulting into huge constellations of sound. Making it a genuime performance instrument for concerts.

APPLICATIONS

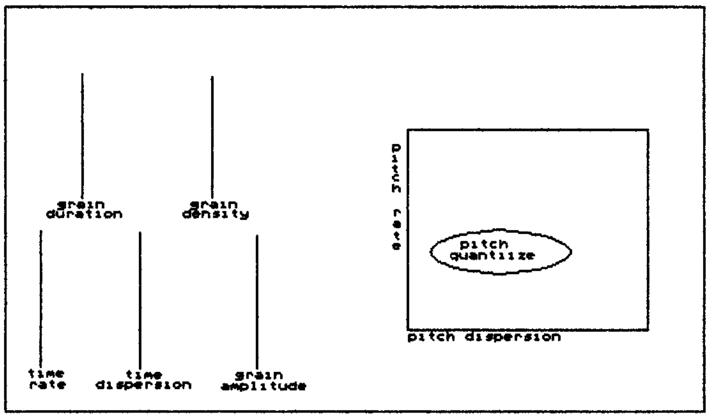
The aim was to develop an instrument, that was capable of stratifying patterns in complex signal processing and synthesis techniques in realtime during a performance situation on stage, with the explicit need to control many parameters at the same time. In order to do this, one needs a set of coherent approaches to the mapping of combinations for the full exploration of these possibillities.
Some approaches were in 1997 described a.o.by Philippe Depalle (3):

One-to-One Mapping :	Each independent gestural output is assigned to one musical parameter, usually via a MIDI control message. This is the simplest mapping scheme, but usually the least expressive. It takes direct advantage of the MIDI controller architecture.
Divergent Mapping :	One gestural output is used to control more than one simultaneous musical parameter. Although it may initially provide a macro-level expressivity control, this approach nevertheless may prove limited when applied alone, as it does not allow access to internal (micro) features of the sound object.
Convergent Mapping :	In this case many gestures are coupled to produce one musical parameter. This scheme requires previous experience with the system in order to achieve effective control. Although harder to master, it proves far more expressive than the simpler unity mapping.

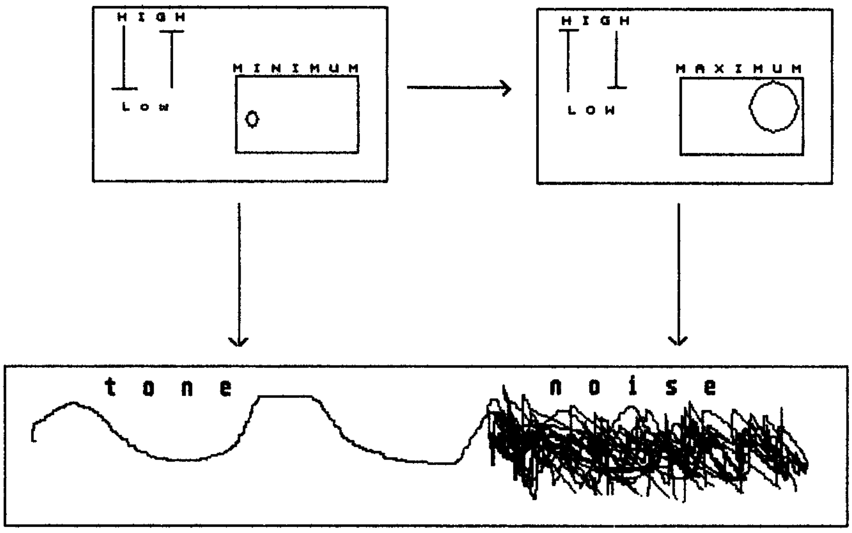
Thanks to the increasing speed of processors in computers like the Power Macintosh and the Silicon Graphics workstations, it is now possible to realize signal processing inmediately with programs like **SuperCollider** (James McCartney) and **CAST** (David Wessel), which otherwise would have taken minutes

not mention hours or days to calculate. In the early days specialized systems with custom built DSP-boards (the Next-machine with Ariel cards for instance) would have been needed to do these things on stage during live concerts.
As such it became less of a problem to design an instrument and integrate it into a realtime synthesis and processing environment like SuperCollider. Because of its specific qualities SuperCollider makes it possible to get impressive results.
During concerts in Germany and Holland in 1998 I used James McCartney's implementations of granular synthesis and granulated pitch-transposition. With specific aims in mind of having transformation-possibilities over the axis from completely recognisable sounds to completely distorted ones I experimented with several mappings, with the following results:

One-to-One Mapping :	slider 1 *grain duration* slider 2 *grain density*
Divergent Mapping :	x-y-z pad controlling *pitch rate/ pitch dispersion/ pitch quantization*
Convergent Mapping :	the combination of gestural movements results in a fluent control over the timbral axis from tone to noise



When slider 1 has its lowest value, slider 2 its highest and a position is taken on the x-y-z pad somewhere left in the middle with no pressure applied, the sound is clearly recognisable. However if the values of sliders 1 and 2 are inverted and a position is taken on the pad in the uppermost right corner with full pressure, it has changed into a complete distorted one. These are just the opposites of a scale from tone to noise, with all the possibilities of nuances in between.



CONCLUSION
Because of the design of the stratifier in combination with a program like SuperCollider, one is able to put complex signal processing and synthesis techniques on equal footing with acoustic instruments during concert-performances and making it thus into a real instrument.

Arie van Schutterhoef
Schreck Ensemble
The Netherlands

REFERENCES

(1)	-Gerald Bennett 1990:	*"Notes on Electroacoustic Music"*; published in the French language in the autumn edition 1990 of Contrechamps, Geneva.
(2)	-Axel Mulder 1994:	*"Virtual Musical Instruments: Accessing the Sound Synthesis Universe as a Performer".* First Brazilian Symposium on Computers and Music.
(3)	-Joseph Butch Rovan, Marcelo M. Wanderley, Shlomo Dubnov, Philippe Depalle	*"Instrumental Gestural Mapping Strategies as Expressivity Determinants in Computer Music Performance"* Presented at *"Kansei - The Technology of Emotion"* Workshop at Genova/Italy on 3rd and 4th Oct./97.