The Contributions of Computer Music Pioneer Knut Wiggen

ABSTRACT

Knut Wiggen (1927-2016) was active in Stockholm as director of the concert organization Fylkingen (1959-69) and as the founding director of Elektronmusikstudion (EMS) (1964-75). These positions gave him enormous influence in Swedish contemporary music at the time, but following his departure, his achievements were quickly abandoned when the studio changed focus towards more conventional tape-based composition. The reasons for this abrupt change have previously been discussed, as has the broader outlines of his work,[1] and recent research has focused on the thoughts that guided his entire development of the hybrid studio and resulted in his radical composition software MusicBox.[2] MusicBox has not previously been presented for the computer music community, much due to the fact that EMS discontinued the development upon Wiggen's departure in 1975, and because Wiggen brought the code with him when he left.

This article describes Wiggen's achievements in an international perspective, and gives an overview of the composition method employed in MusicBox in one of his published musical studies. A more detailed analysis can be found in [3]. The consequent radicalism in Wiggen's thinking is striking, as is his understanding of why new technology needed to be appropriated in the arts, and if this presentation helps lifting Wiggen's contributions from obscurity into the canon of early computer music pioneers, it has been successful.

1. BACKGROUND

Wiggen was born in a hamlet near Trondheim in Norway in 1927, and moved to Stockholm in 1950 to pursue piano studies. One of his teachers, Hens Leygraf, brought him to a Darmstadt summer course in 1952, and Wiggen remained in Darmstadt until 1955, absorbing the different developments in contemporary music, especially electronic music. His notated works from this period are clearly modernist and atonal, however with poetic qualities and not strictly serial in construction. Wiggen gradually came to the realization that interval-based music would not be sufficiently radical for capturing the essential affordances of modern technological and social development, and turned to electronic music.

When Wiggen returned to Stockholm, he quickly came into contact with the social democratic think-tank *Mondagsklubben,* where leading intellectuals debated and mapped out the implementation of cultural initiatives. In brief, Sweden had undergone a significant centralization of its population, which in combination with old capital had resulted in the development of important industries in many fields, among them electronics. It was believed that this new social situation would require new cultural initiatives for participation and not only consumption, and this necessitated building arenas and using technology to create a new music that would better suit the current development and social conditions than the (obsolete) bourgeois musical paradigm. The need for new musical languages was a driving motivation in modernism, but the social orientation was Wiggen's, in strong contrast to the viewpoints of for example Milton Babbitt.[4]

Wiggen quickly became a spokesman for the new electronic music, and used every opportunity to press upon decision makers and public the importance of bringing artists and composers in contact with the new technology and the new media of broadcasting. He argued that without inclusion of techniques built on the new affordances, music would become irrelevant and unable to fill its share of responsibility for developing the new society.

2. EARLY WORKS

Wiggen's first electronic work was a digital music machine that consisted of printed circuit boards mounted in a vertical column. Random processes filtered, cut up and distributed the white noise generated by the cards to nineteen loudspeakers that filled Liljevalcks konsthall in 1961. The filters could vary in bandwidth from a full octave to only 2% of an octave. The sound was also 'cut up,' producing a result that could oscillate between mere pulses and stable frequencies in a range up to 10 KHz. The bandwidth of the filter and the cut-up ratios could partially also be controlled manually. In this way, *Musikmaskin I* could produce pulses, tones, percussive sounds or crackling, and Wiggen described it as a "discovery-machine" for exploring transitions between pulse and frequency, and between frequency and colored noise. In a German text about the installation, Wiggen describes it as just as good of a tool for psychoacoustic research as the symphony orchestra.[5] The installation has since been lost, destroyed when EMS moved from their first location in Kungsgatan.

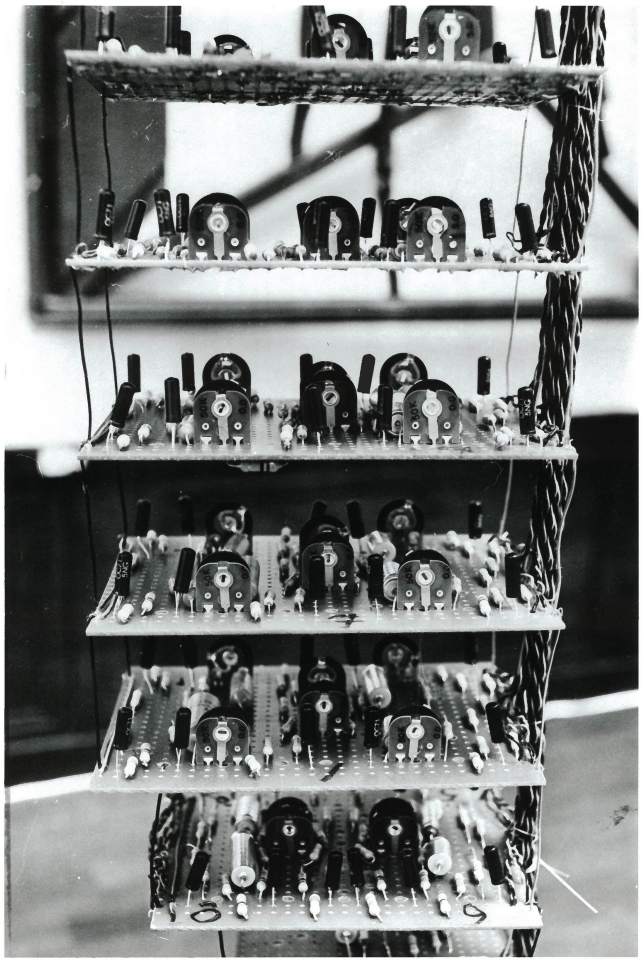

Figure 1. *Musikmaskin I*.

In the early 1960s, Wiggen also experimented with conventional interval-based algorithmic composition for instruments, and composed at least two works, *Wiggen-1* and *Wiggen-2*. Not much is known about these pieces, but they did receive press attention in Sweden, and Wiggen discussed them with Lejaren Hiller during his visit to Urbana in 1965, just a few years after Hiller and Isaacson had made *Illiac suite* (1957).[6] This piece is generally thought of as the first computer-generated work.

3. ELEKTRONMUSIKSTUDION (EMS)

The first opportunity to build resources for composers came in 1961, when a studio for electronic music was built at Arbetarnas Bildningförbund. This link to a socially progressive organization exemplifies the strong connection between musical and social radicalism in Sweden at the time. As soon as the studio was operational, Wiggen invited composers from the network he had developed while in Darmstadt, and courses with for example Gottfried Michael Koenig attracted young composers like Lars Gunnar Bodin to the studio, and to become Fylkingen members.

It was when funding for the new large studio was provided by the Swedish Radio in 1964 that Wiggen could realize the plans he had developed during his travels around Europe and the United States, and that he had described as a new musical instrument - *the Symphon* - in a conference he organized in Stockholm in 1963 with participation of among others Iannis Xenakis from Paris, Jozef Patkowski from Warsaw and Herman Heiss from Darmstadt.

Key challenges with contemporary tape techniques were their lack of exactness, the laborious studio work in tape splicing (and the resulting long production times), and the lack of real-time possibilities. The sound generators and processing equipment would not keep stable settings, and this reduced the compositional precision. In addition to these obvious problems, Wiggen also thought that the conventional acousmatic music suffered from too little structure, and relied too much on the composer's personal taste and too little on compositional logic and the extraction of features from the affordances of the new technology. Wiggen was interested in how the computer could be incorporated deeper into the composition process than just by selecting pitches from a script manufactured by the composer.

Building a hybrid studio where analog equipment was controlled by digital means made it necessary for EMS to build the equipment in house. In the main studio, where the development work took place, there were 24 oscillators plus noise generators, reverb units, and ring- and amplitude modulators in addition to several tape machines.[7] The separate "tape workshop" was equipped in a more conventional fashion. In his survey of contemporary studio facilities, James Beauchamp described the studios at EMS as the foremost facility for composers in the world.[8]

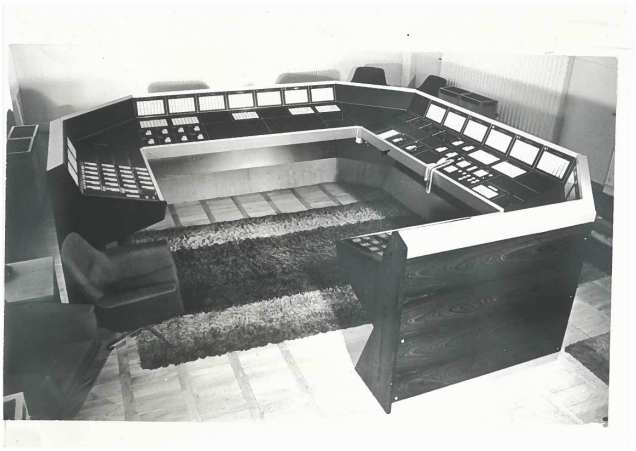

Figure 2. The control console in the EMS main studio.

The real-time issue was addressed by a 9 meter long control console where all parameters for the sound equipment was laid out on the surface. The interface was a copper brush that would open or close the circuits. The composer could improvise and perform music on the console, and record the

control signals on tape, or she could play control signals from tape and to some degree modify the music when it was playing.

The computer, a PDP 15, arrived in 1970, after early work on a SAAB computer made it clear that EMS needed a dedicated resource. The machine, however was unable to calculate sound in realtime, thus the reels only contained the streams of control signals themselves.

Much research during the 1960s and early 1970s revolved around real time hybrid technology, and well-known examples are Moore and Mathews' *Groove*, Gabura and Ciamaga's *The Piper*, and Zinovieff's system that was used in concert as early as in 1967.[9] But EMS developed the only full-size studio real-time implementation.

4. A NEW COMPOSITION METHOD

Wiggen wrote repeatedly about the need for a new composition method that would draw directly on new technological affordances, and criticized conventional tape music techniques where composers listened to the material in order to find elements to work with. He was also unhappy with the procedural languages in the Music N-family where instruments and scores were specified separately, and believed this approach made it difficult for composers to go beyond the interval-based paradigm.

As Iannis Xenakis, Wiggen wanted to use mathematical functions to describe overall forms and shapes, but not the individual events. Wiggen know Xenakis' theoretical work *Formalized Music* from 1963, but his ideas did not stop at the mathematical principles. He crafted an object-oriented environment where functions would be encapsulated in "boxes" that could be freely interconnected, and where the flow of numbers was converted to musical parameters for sound and spatialization only at the end of the process. Wiggen's *MusicBox*-program was the first example of this composition method in the world, similar to the approach in many high-level softwares today.

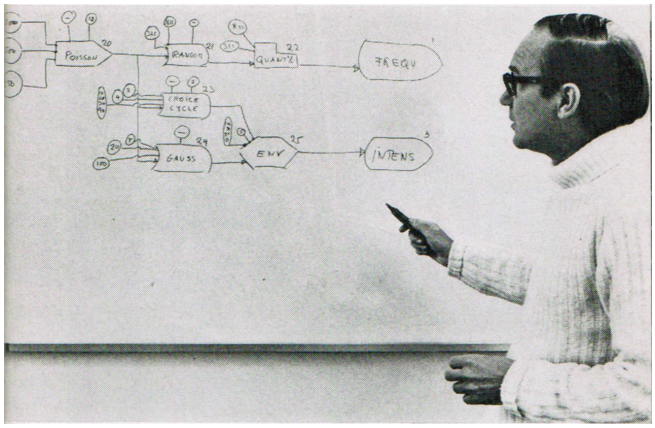

Figure 3. Knut Wiggen showing a *MusicBox* patch.

This environment made it possible to employ principles from sciences as structuring elements in composition, and more importantly to create structured and consistent co-variation of different parameters, removing the need to describe each pitch event in detail.

Wiggen experimented with this working method in several musical studies, and while most of them have remained unpublished, 5 studies (*Sommarmorgon, Resa, Etyd, Massa, EMS för sig själv*) were printed on a DTS 5-channel CD in 2004 and will be re-released in 2018. Some of the pieces have been performed a few times, most notable *Resa* which was also performed at the MIT-hosted first computer music conference in 1976. His piece *Sommarmorgon* has seen the most performances, and this is also the piece Wiggen chose to reconstruct for a celebratory event at the Bergen International Festival in 2009.

5. SOMMARMORGON

MusicBox was migrated from Fortran to Java in 2003 NTNU in Trondheim, replacing the dependency of the EMS sound generators (for which it was originally programmed) with computer synthesis. Shortly after, it was given a graphic interface by one of the original EMS programmers, Zaid Holmin. Wiggen reconstructed *Sommarmorgon* in this new version of *MusicBox*, and the new version is not identical due to the different seed values and use of random numbers. It is however easily recognizable, and this evidences that the structuring nature of the score are effective.

A closer look at the score shows Wiggen's use of systematic co-variation, in the sense that the mapping of numbers to sets of timbral values was consistent, and that the underlying stream of numbers provided a very similar large form to the composition. Wiggen likened the differences between the versions to how interval-based instrumental music varies from concert to concert.

A closer look at the graphical score from *Sommarmorgon* reveals the type of co-variation Wiggen implemented in his composition process.

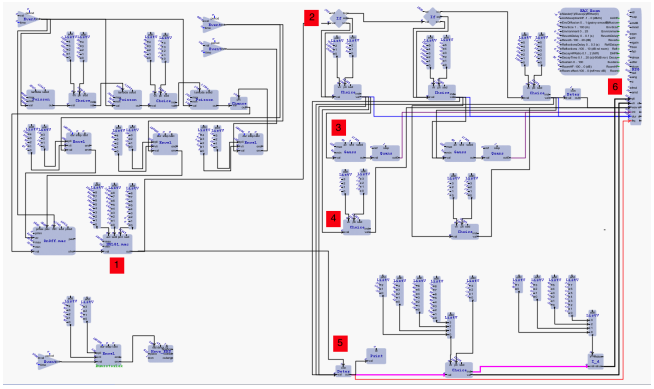

Figure 4. The *MusicBox* patch for *Sommarmorgon*.

A brief explanation: Figure 4 shows the boxes that produce *Sommarmorgon*. The total duration of the piece is set to the left, and the box (1) outputs a stream of numbers with three Gaussian peaks. The stream of numbers is passed to the top (2) and bottom left (5) on the right side, and at the top, the numbers are separated into three groups (0-200) (200-1600) (1600-14 000). Each number is used for selecting between numbers that are different for the three groups, so that low numbers select larger numbers. These are used to set pitch durations. The selected numbers are also used as triggers for further selection of intensities (amplitudes) that vary within defined ranges (3), as well as waveforms. The likelihood of a low number to trigger a sine wave is twice as high as for triggering a sawtooth or squarewave, (4) while the midrange numbers (200-1600) invariably choose sine waveforms. Finally, at the bottom of the right side of the patch, each number is used directly as frequency, and is used to select between four different envelopes.

So, for example the low-pitched sounds that Wiggen has described as big birds passing, all have long durations and a 50% chance of not being a sine wave, while the high-pitched sounds will all be sine waves, and short.

6. SUMMARY

Wiggen's comprehensive thoughts on the need for the arts to develop new methods for fully utilizing the affordances of the new technology had a surprising goal – the listeners' experience of atmospheres, as a psychological resonance to something familiar. He was holding back in publishing his software until he felt certain that this type of artistic success was attainable with *MusicBox*.

Without the technology, the arts would lose contact with their social context, and without the resonance, the artistic expressions would not be successful and find an audience. Wiggen's project was to anchor both the arts and the technological development in human psychology, in order to fully connect people with the necessary arts of the future. Wiggen must have agreed with Luciano Berio's statement that the technology-based music did not constitute a radical break with the past, but a logical continuation of ancient motives and developments.[10]

7. ACKNOWLEDGEMENTS

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8. REFERENCES

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[4] Babbitt, Milton, "Who Cares If You Listen," *High Fidelity*, February 1958.

[5] Wiggen has described *Musikmaskin I* in two available documents - one in Swedish and one in German. The more technical description is in German. Both documents are located at The National Library of Norway. Copies in the author's archive.

[6] Hiller, Lejaren, "Music Composed with Computers – A Historical Survey." In *The Computer and Music*, edited by Harry B. Lincoln. Ithaca: Cornell University Press, 1970.

[7] Wiggen, Knut, "The Electronic Music Studio at Stockholm. Its development and Construction." *Interface*, Vol. 1: No. 2. Amsterdam: Swetz and Zeitlinger, 1972.

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[9] A recording of this performance can be seen here: https://www.youtube.com/watch?v=F_9oSQaYbNQ. The relevant excerpt starts at 2:38. Viewed February 7, 2017.

[10] Luciano Berio wrote in 1953: " ...the electronic creation or manipulation of sounds should be seen as a phenomenon not of schism but of continuity, springing from the same historical and human motives that guided the development of music from Palestrina to Dallapiccola." The quote is taken from: "Musica per Tape Recorder". In *il Daspason*, IV. No. 3-4. Pp 10-13. Reprinted in Maria Maddalena Novati and Dack, J., Eds., *The Studio di Fonologia*. Roma, Ricordi. p. 4, 2009.