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# DANCES WITH ROBOTS AND THE SONG OF ALGORITHMS

Mattias Parent & Maarten Quanten

# ON A FEW FLEMISH COMPOSERS BETWEEN MUSIC AND TECHNOLOGY

*"The springs of the human machine are such that all the vital, animal, natural, and automatic motions are carried on by their action. In a purely mechanical way the eyelids are lowered at the menace of a blow and the pupil contracts in broad daylight to save the retina, the pores of the skin close in winter so that the cold cannot penetrate to the interior of the blood."*

Julien Offray de La Mettrie, *L'homme machine*, 1748

**Godfried-Willem Raes, *Symphony for Singing Bicycles,* photo Logos Foundation ◄**

The twentieth century in music is almost unthinkable without electricity. This controlled physical phenomenon contributed to radio, brought about a revolution in sound recording and reproduction, and made electronic sound production possible. The mutual influence of music and technology has of course existed for centuries. Bone flutes had to be carved, all kinds of membranes needed to be made supple and then stretched taut. Max Reger's organ works would have been radically different without pneumatic tracker action, and the *Gesang der Jünglinge* is unimaginable without a tape recorder and pulse generator. In many cases, new forms of musical expression have only been able to emerge thanks to technological developments occurring outside the specific artistic context. Think, for example, of the automated instruments originally intended to reproduce existing music but simultaneously bearing the potential to transcend certain motor characteristics of the human performer. Conlon Nancarrow made use of this in conceiving his hyper-complex *Studies for Player Piano*, whereas composers such as Igor Stravinsky were also interested in the mechanical quality of automated music, which implied freedom from human expression. The machines heralded a new aesthetic that superseded their original reason for being built. A somewhat more recent example can be found in the electronic studios where high-tech electro-acoustic measurement and recording apparatus was used non-idiomatically to generate, modulate and combine synthetic sounds. These procedures were used, for example, to realise the radically multiple serialist ideas of composers such as Karel Goeyvaerts and Karlheinz Stockhausen. Once electronic music had become a fairly established phenomenon – from the early 1960s onwards – engineers and physicists were also brought in to develop specific apparatus intended to generate electronic sound complexes. The Institute for Psycho-acoustics and Electronic Music (IPEM) in Ghent is a perfect example. This was where the engineer Walter Landrieu built several analogue sequencers for a university 'research and development' project that were intended to automate some of the – highly labour-intensive – studio work. In doing so he collaborated closely with composer Lucien Goethals, who was familiar with the musical context and was making further explorations in that area (Landrieu and Goethals, 1973, p. 71-99).

Humans *used* the machine to create sounds and larger musical structures that had not existed until that moment, a practice that corresponded perfectly with the post-war artistic attitude that radically focused on innovation. Nonetheless, two tendencies in the artistic approach to new technology can be discerned, be it a little crudely. For example, there were composers such as Louis De Meester who used the equipment in a way that did not greatly differ conceptually from the familiar acoustic instruments. They integrated electronic sounds into their musical idiom (which was already more or less developed), although they did not necessarily try to imitate traditional instruments. For others, the specific principles of sound synthesis and compilation techniques led to a fundamental renewal of their thinking on musical structures and forms. Gottfried Michael Koenig described such artistic methods in several of his texts on early electronic musical practice (Koenig, 1964, p. 288-293). Configuring the instruments was not just an incidental technical job like tuning a piano: the technical experiment was intimately linked to the exploration of the musical material, composition and playing – a symbiosis of science and art. Orderings of electronic sound that refrained from any experimentation easily led to synthetic mimesis of instrumental music and its techniques. Karel Goeyvaerts, however, initially focused on the sine tone generator and tape recorder because he believed technology would offer him a solution to aesthetic problems he did not think he could solve with traditional instruments and musicians. Take his complex serial work structures and their reflection in sound structures, for example, and his search for 'static music'. Goeyvaerts composed his *Nummer 4 voor dode tonen* in December 1952,

**Performance of Stefan Prins' *Infiltrationen* by ZWERM and the composer**
**filtr Johannes Westendorp, Matthias Koole, Stefan Prins, Toon Callier, Bruno Nelissen ▼**

in the period when Stockhausen was creating his *Konkrete Etüde* during his internship with Pierre Schaeffer in Paris. *Nummer 4* was the first multiple serial work to use exclusively synthetic sounds, but then the problem of actually *making* it arose. The trouble was that Goeyvaerts could not get permission to experiment at the Belgian radio studios. After all, Belgium had no Herbert Eimert at the time to plead the case at the large institutions for taking such new artistic directions.

And then came Herman Van San, a radical aesthetic thinker who has been ruthlessly forgotten by history, even in his own country (Sabbe, 1998, p. 77-78). In the early 1950s he tried to find a place for himself in multiple serialism, then went on to develop a highly complex form of mathematical and technological musical thought. Van San seemed to be searching for an artistic experimentalism that aimed to reject completely the historically developed ideas on musical form, in a way that was probably even more radical than that of his more famous contemporaries. Research into algorithmic techniques for organising sound material was, for him, inextricably linked to this principle. It was clear that in these circumstances technology could no longer serve as a 'musical instrument' in the traditional sense of the word. Instead, the exact sciences in general and (audio) technology in particular provided a means to study and generate structures that *might* make sense in a musical context. In the late 1950's, Van San went to Cologne to create parts of his *Opus Electronicum Mathematicum* in the WDR studio, mentored by Koenig. He did not succeed, and the piece remained a mere concept. At least until Peter Swinnen went to work on *Csound* in 2000 and the piece was premièred at the TRANSIT festival in Leuven more than forty years after it was composed. Maybe it would be a good idea for musicologists of the future to get to grips with his exceptional ideas, even though his influence on music history was very limited.

Lucien Goethals experimented with synthetic sound production and modulation and contributed, as already said, to the automation of the IPEM studio. In 1966 he wrote and created a noteworthy serial electronic work, *Contrapuntos*. Its sound complexes are an example of musical structures that arose from the protocols of the studio – *ars technologica*. Short, raw sound particles (sine waves, square waves, noise but also samples of piano clusters) are combined into electronic *Klanggestalte* that are easiest to describe in terms of forms of movement or tendencies in frequency space. In that sense Goethals' music is clearly related to the (electronic) group and field compositions by people such as Stockhausen and Koenig. However the work demonstrates an idiom of Goethals' own, infused with a modern but sensual use of counterpoint. *Contrapuntos* consists of twelve layers of material mixed in a stereo version. This electro-counterpoint technique – the synchronisation of 'monophonic' layers into a 'polyphonic' whole – was also a necessity in the studios and encouraged composers to shape their music on the basis of such production methods and protocols. In itself of course this would not be particularly remarkable, were it not for the fact that Goethals also made a version of the work in which layers of material (or collections of such layers) were played on separate tape recorders. Switching the machines on or off was moreover done with signals from photo-electrical cells that reacted to the movements of concert-goers walking around. Goethals had created an interactive installation that generated an aleatoric, spatial counterpoint.

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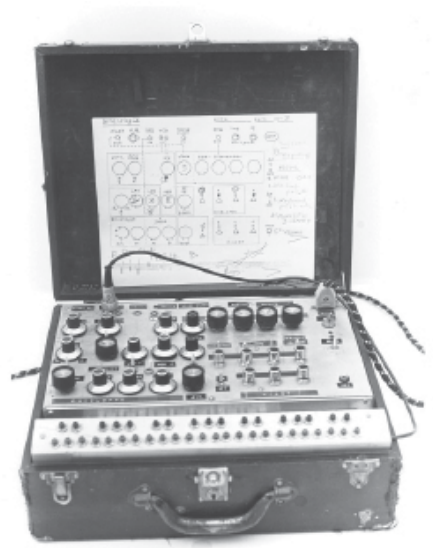
Godfried-Willem Raes founded the Logos group in 1968 in Ghent, along with several other students who shared his views. Even back then he was a ferocious opponent of the 'conserving' mentality of Ghent Conservatory and developed into a militant advocate of musical innovation. In Raes' eyes, aesthetics were and are inextricably linked to a wider ethical and political reality. His own experimental artistic orientation developed in parallel with certain anarchist and Marxist political ideas. In that sense the Logos group was related to the British Scratch Orchestra and its members performed music by, for example,



# NEW TIMES CREATE NEW CHAL-LENGES



Synthelog, photo Logos Foundation ▶

Cornelius Cardew, Christian Wolff and Mauricio Kagel. Although Raes currently works as a lecturer in composition at Ghent Conservatory, he was thrown out of the institute for refusing to engage with old music. This radicalism was closely intertwined with an intense interest in technology that he used as a means for and object of artistic experimentalism. In the 1970s, this interest was mainly translated into an exploration of electronic sound production. It is striking that Raes – just like Michel Waisvisz in the Netherlands and Hugh Davies in England – soon began designing and building his own instruments, sound sculptures and installations. That practice became an integral part of his artistic activity. The medium of sound sculpture straddles the border between construction, composition and music-making. The direct interaction between the audience and the installations, and the disappearance of the dividing lines between stage and audience also represented an artistic materialisation of Raes' political ideas. Thus he also questions the strict division between musical amateurism and professionalism, for example. What is less obvious is that his stage instruments also have formal characteristics shaped by ideology. An example here would be his Synthelogs series (1976), consisting of small analogue synthesizers. They do not have piano keyboards, because he believes that a keyboard would impose the logarithmic division of the octave, as the symbol of old and commercialised music, on the musician.

Godfried-Willem Raes with his *Toetkuip*, photo Logos Foundation ▸

Godfried-Willem Raes' relationship with means of electronic sound production is a complex one. On the one hand, technology provided an obvious area of experimentation for a composer whose artistic thinking was self-evidently progressive, and who moreover displayed an explicit passion for and knowledge of engineering sciences. On the other hand, we note a disappointment in the medium that we would like to sketch briefly here in three points of concern. Firstly, Raes soon came to consider electronically generated sounds as simplistic 'caricatures' of complex acoustic sounds. After all, they were formally rooted in Fourier schemes (think of the forms of sound synthesis in early serialism). Raes considered them as a mathematical reduction of the complex nature of sounds into an idealised regularity and schematic two-dimensionality. Secondly, he believed that (live) electronics in a concert setting were susceptible to mystification, inspiring awe. This was not the reaction from the audience that Raes and the Logos group were seeking. Rather than a technological tour de force, they wanted the artistic experience to be central. The third point is somewhat related to this: in the context of (early) live electronic music, the direct relationship between the musician's physical gesture and sound produced was lost. A light touch on a tiny potentiometer, for example, could bring about a serious parametric movement – Superman sending a juggernaut into the stratosphere with a flick of his little finger. The electronics responsible for sound production and parameter modulations were hidden in sealed boxes. Raes' ideal, however, was a naked openness of systems. His artistic and political visions, here, are metaphorically intertwined.

It may be clear that Raes' aesthetic ideals are a far cry from the modernist aspiration towards new sound complexes, as was customary at analogue electronic studios such as the IPEM. His criticism of electronic sounds and equipment was inextricably linked to his compositional and/or instrument-building concepts. For example, he viewed the Synthelogs explicitly as 'magic boxes' and the demystification of the equipment and sound sculptures occurred when the audience touched and played with them. Raes continued to use electronics, but only in work involving explicit caricaturization: as a soundtrack to political cartoons (mocking the establishment), for example. However, many of his instruments, installations, sculptures and performances are based on acoustic sound producers (e.g. the Pneumaphone Project, see photo) or electronics with highly intuitive or physical characteristics. The *Symphony for Singing Bicycles* (1976), for example, is to be performed by cyclists whose bicycle is fitted with an electronic oscillator driven by a dynamo. This composition/performance/installation is suffused with




Raes' aesthetic. It is performed in public spaces, by professional or non-professional musicians or even non-musicians. Sounds, clusters and gestures arise that do not conform to the (unwritten) laws of what is normally heard in public spaces (i.e. muzak). The electronic sounds are raw, naked, divested of invisible and mystifying modulations or transformations and connected to the physical gesture of cycling, the translation of pedalling speed into a frequency. A number of Raes' instruments are designed as 'electrical' and not 'electronic' for exactly that reason. In this context we mean by that that the musician touches an object leading to the material and/or surrounding air being made to vibrate. The latter is then converted using transducers (pick-ups, air and contact microphones) into an electrical vibration pattern whose acoustic manifestation is a direct consequence of the physical contact between the musician and the instrument.

The fusion of aesthetic innovation and technology in Raes' work is also reflected in his composition process. He developed algorithms for this early on. After all, one could claim that the creative act of composing, in the eyes of the composer, is far less a matter of merely executing and varying on a (shared) system of rules than intervening in and developing the rules that connect sounds for a composition or group of compositions. This is why the young Raes opposed conservatory practices such as tonal harmonics, classical counterpoint and traditional fugue techniques that hinder free creative think-

ing and result in a mixture of academicism and craftsmanship. This is also where his distaste for modernist composers lurks, who tried to develop new 'big systems' that would apply across the board (e.g. certain approaches in multiple serialism or spectralism). Raes' *Book of Fugues* (1992-1993) is a good example of a formalised collection of artistic ideas that can theoretically generate countless compositions. A computer programme like this one incorporates composition, perhaps it even is the composition; it contains a systematised aesthetic that can be infinitely materialised in the form of numerous variations. The craftsmanship in composing work is contracted out to machines; humans determine the creative rules and musical foundations (such as how the *comes* is related to the *dux*). Technology is a liberating force here, ensuring that humans only need to concern themselves with the typically human aspect of artistic production – creation instead of mere variation. Such a composition moreover contains implicit criticism of several forms of artistic behaviour, due to the fact that it makes certain of their automatisms explicit – or, if you prefer, demystifies them. The fugue (or counterpoint in general) is after all not only one of Raes' favourite points of musical interest, but also an important symbol of conservative musical education.

The principle of automation did not only interest Raes for what it could bring to the composition process, but also for how it could change concert performances. Automated musical instruments have existed for several centuries, of course, and Nancarrow used them extensively to supersede human limitations in performance practice.[1] Raes' first automata were fairly small, digitally controlled acoustic instruments that needed amplification to be heard. Later the machines got bigger and could be used as fully acoustic instruments. Today his robot orchestra includes several organs, a piano, a spinet, percussion, brass, wind, strings and even a rain machine – about fifty machines in total, with more being added each year. Just as with Nancarrow, the technology is intended to outstrip human cerebral and mechanical limitations. This can be done very simply, by giving the automaton a fixed program that converts a musical structure formulated as a collection of parameter values into a succession of mechanical actions (a good example is Raes' *Vibes for Vibi* from 2001): in other words a digital version of the punched piano roll or carillon drum. In this sense Raes' automata clearly do share common ground with the tape recorder in early electronic studios: the machine makes it possible to play unplayable musical structures. With the machines, however, every sound-producing action is visible, taking place in the concert hall: robotic hands, feet and lips play real musical instruments in real time, and there is a direct and intuitive link between movement and sound. The instrument builder works on the same aesthetic assumptions as the composer: philosophy becomes politics becomes technology becomes music.

The task of human musicians in the situation described above is limited to programming the automata. They disappear from the stage; their physical actions and musical movements are no longer relevant. However it was not Raes' intention to make human musicians disappear; on the contrary. The interaction between human and machine has even become one of the central aspects of his artistic work in the last few decades. More specifically, he has developed interfaces that convert movements or sounds into commands for the robots (projects such as *Hex*, *Holosound* and *Namuda*). This artistic practice, too, can be seen as a criticism of the overruling Western music culture that is almost completely focused on the specialist musician and the resulting virtuosity. 'Classical' music-making is in that sense entirely interwoven with a standardised set of performance conventions or reproduction standards. The Romantic focus on (and cult of) the virtuoso – as we still find celebrated today at the high mass of the music competition – can after all only flourish by the grace of that shared collection of norms and values. Hence these values risk gaining an almost absolute nature and generating a (dogmatic) basis for comparison. However, machines outstrip humans here in terms of motor skills and mechanical flexibility, just as they are faster than biological brains in 'thinking of' a *comes* for a *dux*. A sensor system can liberate the musician from the traditional armoury of instruments that is now wrangled by a computer brain, mechanical fingers and a pneumatic mouth. Body movements are converted into a series of commands that control the machines. The 'dancing musician' can play a whole orchestra at once, his or her actions no longer limited to the single instrument whose characteristics have been intensively internalised over decades. Once again, the dividing line blurs in Raes' musical culture between the professional and the amateur. The 'instrument' moreover incorporates the score (or part of it). After all, the composer creates an algorithm that describes the reactions of the robots to the movements of the performer. The latter improvises, dances a choreography or does both, and the role of performer may even be taken on by the audience if the machines are set up as an installation.

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In the 1950s, electronic technology promised to open up a whole new creative world of sound. As time progressed, composers gained ever-increasing control over the pixels of music, the atoms of sound. The musical avant-garde developed an unprecedented interest in technology, an artistic rocket that would carry them up out of the traditional Western aesthetics. Many of us have already connected serial aesthetics, the general rationalism and progress-based thinking of the 1950s and a form of 'post-Auschwitz' ethics. The development of unheard musical structures, work forms and sound forms belonged in that context. When Herman Van San said that he wanted to rid music of emotion and infuse it with mathematical rationality, he was invoking a far wider, shared current of thinking. Such aesthetic ideas bear witness on the one hand to a rejection (to a certain extent) of old norms (or at least the reproduction of these norms), and on the other hand they express hope for a future in which the formal beauty of structures that were traditionally 'non-musical' could become musical – electrons and algorithms, quantum mechanics. Musical expression, here, demands from its audience a far-reaching empathy with otherness as a condition for communication. In this context aesthetics are anything but detached from life, even if they perhaps take on an unprecedented form of sensual stubbornness. Or to put it in the words of Gottfried Michael Koenig:

> ***"An audience that only calls music 'human' when it understands it, but only perceives in music that which a machine could register, does not have a human relationship with music. This cannot be restored until the perception of art emphasises specifically human capacities, such as the ability to understand new things. Recognising familiar things is not understanding. In this sense electronic music that appeals to a specifically human capacity should be more human than instrumental music decorated with glamorous titles but afraid to tell the audience more than it already knows."***
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> Koenig, 1962/1963, p. 77

Godfried-Willem Raes' artistic production is explicitly infused with ideology at many levels. His multifaceted work is political, and hence so is the constantly present technology, although he does not always entirely affirm this. Technology, the machine, frees humans from their limits, through its interfaces becomes an extension of their limbs, vocal cords and maybe other organs as well. These interfaces and algorithms ensure in turn that the performer has access to a whole array of instruments, and that the classical virtuoso

no longer takes central stage. Technology changes and/or renews musical culture, and is formally grafted onto Raes' social and artistic ideals.

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There is a certain area of common ground between Raes and Stefan Prins (°1979), the young Fleming who came home from the Internationale Ferienkurse in Darmstadt in the summer of 2011 with the coveted Kranichsteiner Preis for composition under his arm. The composer's first degree was in electronic engineering with a specialisation in photonics. Nowadays he usually works with Max/MSP and almost all his work includes a technological component. His electronic sound material is often produced with granular synthesis techniques. In that sense he is affiliated to a tradition of 'modernist' electronic sound experimentation that characterised the second half of the twentieth century in music. Incidentally, this also applies to Prins' use of algorithmic composition techniques. He also experiments, among other things, with improvisation, sampling interfaces and sound synthesis using analogue (no-input-mixing) and digital feedback.

It is striking in Prins' early work that communication, interaction and symbiosis between human and technological systems is not only a means or an instrument for creating musical structures, but also a basic conceptual principle. Initially the composer noted the very close intertwining of humanity and the machine in today's world and has subsequently made it a theme of his work. The computer is all but omnipresent, digital communication a recent but undeniable norm. Influence is mutual: humans build and operate machines at work and in their free time; the presence and functions of machines affect human thought and actions. The stronger the control that humans exercise over machines, the more intensive symbiosis often is as well, the branching of electronic tentacles in brains and flesh that – just like with certain parasitic organisms – influence the thoughts and actions of their host. Although this is not a case of a fundamental, or even partial evaluation of 'good' and 'evil', criticism (from the arts world) is self-evident here. This is because the individual's autonomy seems to be affected, especially if we view the human subject through a romantic/modernist (including Marxist) lens. There is certainly a dose of criticism present in Prins' work, but the last thing he does is to express this by avoiding technology or aiming for ultimate control of the alien system by 'naturalising' it further towards humanity, removing the friction. Rather he creates an artificial mirror of that field of tension by transforming the relationships and mechanisms inside it into musically fertile structures and processes. In *Not I* for electric guitar (2007) for example, the composer plays with the alienating effect that live electronics can have on the auditory result of the performer's physical gestures, the non-analogue relationship between touching strings and the sound result that the listener (and performer) associate with that action. The soloist, performing a monologue, loses subjective autonomy – just like the female protagonist of Samuel Beckett's *Not I* (1973) – as another voice, another perspective, breaks in and takes over. He and she are forced into alterity, the 'I' into the 'not I'. In conceptualising the piece for ensemble *Fremdkörper I* (2008), written for a concert programme on the theme of *Entartete Musik*, Prins explicitly links the technological 'foreign body' with the cultural and social 'other'. Each instrument is amplified using a guitar amplifier that is also connected to a computer with pre-recorded, electronically processed material from the same instrument. When the performer is playing, the alien (or alienated?) digital sound producer (or reproducer) is silent; when the performer stops, the technological body immediately forces its way through the amplifier via an electrical signal. The two worlds, that of the flesh, with sounds linked to physical and visible action, and that of sublimated, reproduced and transformed sounds, interpenetrate each other. They move between heterogenity and fusion in a sound world in which alterity is anything but exclusively linked to one of the systems and whose borders can moreover blur. In *Infiltrationen (Memory space #4)* (2009) for four electric guitars and live electronics, the phenomenon of technological infiltration is linked to the idiosyncrasies of the human brain, more specifically memory. The score is generated during the performance by a computer algorithm and contains musical tasks for the musicians to perform. The guitarists can give signals to the algorithmic network, react to what is happening and thus direct the musical 'game' for themselves and the others – humans appear to be the masters of technology and intervene creatively in the art work. But the symbiosis is more complex than that. The computer commands the musicians to remember certain actions and then recall them later. Here technology determines human activity and at the slightest hesitation – as in *Fremdkörper* – it takes over from the musicians: it controls, evaluates and intervenes. The computer appears here as the superior entity in terms of processing speed and memory, and humans have to adjust to technological nature. The basic conceptual principles – though not their development – are related here to Raes' claims for the role of the machine in a creative context. The mere search for new sounds is something Prins has long since left behind. New times create new challenges.

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There is one thing that Goeyvaerts, Van San, Goethals, Raes and Prins have in common: they are not satisfied with the state of things as they are. From their observation of the world and music they extend, add, change, contemplate, question and communicate. In their music, they reflect the newest world in all its complexity, its possibilities, paradoxes and uncertainties – both using and commenting on technology.

Emilie De Vlam, Controlling the robot orchestra, photo Logos Foundation ▼

**Note**

**1** Incidentally, it was Raes who brought Nancarrow's music to Europe in the early 1970s (to the Logos concert hall).

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