<Robodies>

At many occasions I have been asked how I came into starting to build musical robots as well as why the performances using them always involve nudity. So the time might have come to dig into the past, excavating personal memory a bit.

Presumably my oldest exposure to new music dates back to 1958 at the occasion of the World Exhibition held that year in Brussels. I was only a six years old boy than, but my parents did sing in a choir that had to perform many times in concerts organised at the exhibition. They took me along and dropped me in the kindergarten there for the duration of the rehearsals and performances. The ladies that took care of the children there however happened to only speak French. I remember very well that I started crying as soon as they addressed me. I spoke only Dutch and German. As they had no idea as to how to handle me in their kindergarten, they took the initiative to send me off to the Dutch pavilion on the exhibition grounds as there for sure, Dutch was spoken. And, sure enough the ladies there could handle me. They posted me on the first row in the pavilion and thus I had the extreme privilege of experiencing -through eyes and ears- Edgar Varese's Poeme Symphonique many times in a row and on different days. This was the famous Philips Pavilion designed by Le Corbusier but in reality realised by Iannis Xenakis. Needless to say I didn't know these names at the time but the environment left me deeply impressed.

Also in 1958 it was that I got enrolled in the Ghent music conservatory to study the piano. At home we had two pianos -tuned a quarter-tone different, not for the sake of performing quarter tone music, but by accident as one of them was and old but expensive instrument with a wooden frame that could not be tuned to A=440Hz properly whereas the other one was newly bought, for my parents were convinced that listening to the old piano and playing it, would ruin my hearing. Hence the old piano was taboo and I had to do all practising on the newer instrument. I wasn't too bright at it and remember very well that I only wanted to practice if the lid of the piano was taken off completely. I wanted to see the little ducks -my vision as a child on the felt hammers striking the strings- moving as my hands were touching the keys. Mechanics must have fascinated me from early on.

The year 1958 had some importance for yet another unrelated reason: it was the year the Russians launched their Sputnik, the first human object in outer space. I found the idea that it was sending beep-beep messages to planet earth puzzling. Also, I had seen the Sputnik in the Russian pavilion on the world exhibition, as well as the American H-bombs in the USA building... The Russian Sputnik looked so much more friendly than anything I remember from the Americans.

A year later, we moved to a new very large house right across where the laboratories of the Ghent University were situated. I sat for long hours in front of their halfway below street-level windows, just watching the technicians soldering components, performing all sorts of measurements as well as glass-blowing for the chemistry labs. One day, I got a present from one of the engineers. A nice looking component with two wires and coloured rings. I still remember them: red, red, yellow, silver. I asked the man what it was and what it served for. He answered me that it was something as used in the Sputnik. I was all euphoric and made a holstered box to store the component as if it were a precious jewel. I started getting really interested and intrigued by electronics. Soon enough I got to learn that my precious component was a resistor, 220k Ohms in value. By reading typical do-it-yourself boys books, I learned how to build my first radio. With a gallenium crystal, a self wound coil, a crystal earphone and some capacitors and resistors.

Not too many years later, I had build vacuum tube radio's, a tape recorder, amplifiers and, together with some friends at school, a broadcast station working on the FM band... We got it up and working but soon enough the police fell in and confiscated the device. We learned broadcasting was illegal. As we were young boys, the case was closed without further consequences except a talk with the parents, who could barely believe we succeeded doing such things...

As the house we were living in was really large, my parents rented out a room to a university student. That student, Raymond Van Soens, was enrolled for engineering and in his spare time worked quite a bit in the electronic music studio of the university. At some point the entire wall in his room was filled with suspended pieces of 1/4" recording tape. That's how I came in contact with the studio itself as well as with the electronic equipment involved. The IPEM studio, as it was called, organised also new music concerts that I never failed to assist. They deeply influenced my musical preferences and sense for sonic adventure.

At the conservatory at the other hand, things were going very slowly. There was not the slightest trace of adventurous new music there. It was another and very narrow world, unrelated to the real and lively world outside. I gradually lost interest in the piano for two distinct reasons: first of all, the piano teacher, Maurits Deroo, couldn't refrain from sliding his hands into my pants whilst 'teaching' me to play – he was clearly a paedophile abusing me- and secondly, I developed a strong preference for mechanical playing as opposed to the 'emotional' and 'romantic' way I was supposed to use. Technically I went only as far as learning to play Bach's 3-part inventions pretty well and furthermore Bartok's Microcosm. I hated anything romantic and refused to play it. Later on, I made a move towards the clarinet and later to percussion.

The academic year 1968-69 however caused quite a stir. A small group of students gathered together around ideas radically opposed to these underlying the conservatory. We found that the conservatory -and with it the entire world of so called classical music- was merely reproducing the past. There was not even the slightest concern about newly created music. At the academy of fine arts however, it was considered trivial that students would paint their own paintings rather than attempting to copy and/or reinterpret the great masters of the past. Why weren't things going like this at the conservatory? Thus I took the risky decision to refuse to recreate the past and instead called out the will to play exclusively contemporary music from that moment on. I started delving into contemporary music scores from abroad and took contacts with young and experimental composers in other countries. Thus we started performing music by people such as Robert Ashley, David Behrman, Cornelius Cardew, John Cage, Frederic Rzewski, Karlheinz Stockhausen, Richard Orton, Mauricio Kagel...
Soon we concluded that writing our own music would be even a step further and the most radical move into the contemporary we could make. Thus I wrote a composition for the ensemble called 'Logos 3:5'. That piece, scored for five musicians (piano, cello, violin, oboe, flute) required all musicians to play in a different tempo. The five tempi were only related to each other by prime number relationships. As it was nearly impossible to perform the piece without some form of strict coordination, I designed an electronic conducting machine. As came out later on, in fact my very first robot in a way. The tempi -fully programmable on the machine- were indicated to the performers using flashing coloured lights on stage. The performance looked a bit like a disco, although that phenomenon didn't quite exist yet at that time. The piece caused a big controversy at the conservatory, a controversy that did even resonate in the local newspaper. Its music critic headlined 'In cauda venenum...', as my composition was performed at the very end of the concert. The musicians were nicknamed the Logos group and there were even protests of teachers and conservative students against us. However we went on and started working under the name 'Logos workshop'. The conflicts with the conservatory increased and finally, around 1970, we were all kicked out. Logos was born.

So, I had decided to devote my life to new music. Not only did Logos study, create and play it, but also we though that we could not undertake this in isolation. Therefore we also started organising concerts wherefore we could invite artists working along similar lines from abroad. At that time I was elected president of the University Music Club and thus could make use of some subsidy to make this possible. In 1969 I enrolled at the University for studies in musicology and got the degree in 1973.

Several years in a row, from 1970 on, we followed the Ferienkurse fuer Neue Musik in Darmstadt. It's there that we made intense contacts with people such as Warren Burt, Horatio Radulescu (+), Claude Vivier (+), Ladislav Kupkovic and many others.

Although we had made the decision to go for new music, more and more as time went by, we started realising that we were doing this mainly making use of instruments of the past. We came to the insight that this was pretty absurd: as if in our time the perfect tools for musical expression could still be violins, oboes... all instruments developed in the 18th and 19th century. Moreover, the kinds of sounds we were to produce on our instruments more often than not seemed to contradict the nature of these instruments. After all, knocking on a violin sound board isn't really too healthy for the instrument, neither is preparing piano's at the end a valid solution in the quest for new sonic materials... As a consequence we developed the idea that new music calls for new tools for musical expression, read new instruments. And here it is that the knowledge I had acquired in electronic design came in. It seemed obvious that the material to use for new instruments had to be electronics. Not the kind of electronic equipment they had in the studio for electronic music, as that equipment was not useful for performing, but only for the realisation of tape-music. Live-electronics were what dictated the show. So I went off designing all sorts of analogue electronic equipment: voltage controlled oscillators, filter banks, ring modulators, envelope shapers, sequencers, delay lines, programmable mixing boards... I took them on the road and the Logos group used them extensively although not exclusively during our many concerts in the seventies.

By the end of the seventies though a new insight arose, in part also caused by the admiration we often got from audience members for the apparent fact that we could handle all that complicated equipment. Such praise had nothing to do with the music we wanted to make heard and it made us think critically about our endeavours. Two main problems came floating above after a thorough analysis. First the actions we were performing whilst playing on stage (changing patch cords, turning knobs, pushing switches and moving sliders) were completely unrelated in any intuitive way to what could be heard. As a matter of fact, in analogue electronics you often have to prepare a patch by setting all sorts of knobs -without auditive result- and only after that you move the volume slider up and the result can be presented. Such actions lack even the slightest bit of gestural involvement in sound production and thus undermine the rhetoric inherent to musicianship. After all, if we would have play-backed all our concerts, it would probably not have made a difference to the audience and it would have saved us all the hassles of setting the equipment up properly. But a second criticism went even deeper into the problems inherent to live-electronic music. By necessity all sound has to come from loudspeakers. Now a loudspeaker is nothing but a piece of cardboard set into motion by a coil placed in the magnetic field of a strong permanent magnet. If you hear an intriguing sound from a loudspeaker, watching the speaker does not bring you the slightest step further into deciphering the nature of the sound heard. The loudspeaker virtualises the sound. The use of loudspeakers on stage, in particular in the case of electronically generated sound, causes a dissociation between the musician and his utterances. This undermines again the rhetoric of the concert as a social ritual. It undermines the musicians chances to convince, let alone to seduce... A loudspeaker can merely be undergone.

As a radical outcome of these insights, Logos decided to give all electronic equipment used hitherto a fixed place in our electronic music studio and to use it only for the production of tape music,

records and radio broadcasts. That was around 1977.

But rather than going back to using old and classical instruments, we decided to point our research into the direction of acoustic projects and instruments. This lead in the late seventies and early eighties to the creation of projects such as the Singing Bicycle Symphony and the large scale 'Pneumaphone' project.

These projects, although very successful, however left me with a frustration. The instrument and the composition in these cases in fact coincide and cannot be separated. Read, it is barely possible to imagine any other piece to be performed using the Pneumaphones than exactly the Pneumaphone project. The same for the singing bicycles: just about any project imaginable using these devices would sound like my symphony.

What these project lacked was the universality of the musical instrument as a tool for musical expression. With this aim in mind, I started considering the construction of musical robots: acoustical sound sources controlled by electronic circuitry. But, before starting to build the robots as they are known today, I made a side-step somewhere in between: the 'Hex' project. For this project I made a set of about twelve pretty small electro-acoustic modules, to be suspended very near to the audience. Each module contains real physical objects (pieces of spring, membrane, tines, string, plates...) set into motion and vibration via computer controlled electronic circuitry. The Hex project was build up with portability in mind and indeed, we did travel all over the world with it. The sounds although purely acoustic in nature, needed to be amplified in order to make them heard. So we couldn't drop the loudspeakers. The main advantage in 'Hex' was in the richness of the sounds as opposed to the inherent poverty and one-dimensionality of purely electronic sound. Also the computer control paved our path towards the development of much larger and fully acoustical robots later on. 'Hex' was in fact a miniaturised robot orchestra for its own sake, although I have used it only for one single full evening show and some audio art installation projects.

In the early nineties, the construction of large scale acoustical robots took off rather slowly. The oldest robot being Autosax, an automated C-melody saxophone, started in 1989. By the end of the 20th century we had only about seven robots up and running.

We were dreaming about the possibilities of these musical robots, but at the same time had to overcome another very fundamental problem. By using robots the problem of musicianship is in no way solved. Although automating the instruments frees the musician from the mediaeval aspects of craftsmanship, it cancels him out to a great extend as a performer. The music itself can be fully automated without a need for a performing musician.

No matter what musical instrument we can think off, invariably it requires bodily involvement from the musician: bowing, pushing keys, blowing, beating, shaking... are all motoric actions essential to cause a traditional musical instrument to sound. No action, no sound. However these motoric actions in the case of traditional instruments are very specific and pretty difficult to master well. The very fact that we move for making sound, is what makes attendance to a live concert performance into a meaningful ritual. Long before we started the project of the robot orchestra, we developed a system capable of detecting body motion and gesture using Doppler sonar as well as radar technology. The 'invisible instrument' is a completely wireless system based on detailed analysis of reflected waves by the naked human body if exposed to ultrasonic or microwave radiation. The recognition software is largely based on fuzzy logic for classification of gesture properties. A defined set of ten to twelve expressive gestures can be recognized. Namuda dance technique requires a mutual adaptation of the performer and the software parameters. Namuda stands for naked music dance. In order to make the study of Namuda dance possible, we have designed a series of études in which each single gesture prototype can be practised. Since visual

feedback to the performer is very problematic in the context of performance, for it greatly hinders freedom of movement and is by nature too slow, we have opted for auditory display. In the early versions of this technology (applied in productions such as 'A Book of Moves' (1992) and 'Songbook' (1995), wherewith we travelled all over the world) we used samplers and DSP voice processors as sound production engines, depending on loudspeakers.
The robot orchestra as we later designed and built, nowadays makes a very good platform for such auditory display, particularly since the sounds are not virtual (loudspeakers) but real acoustic sounds emanating from real physical objects. In fact just about any musical instrument can be seen as an example for auditory display as it by its very nature truthfully converts a certain subset of fine motor skills and gestures into sound. The gestures underlying music practice may very well constitute a basis for the embodiment underlying the intelligibility of music. The motor skills and gestures entailed by playing traditional musical instruments are obviously instrumental in nature. They are dictated by the mechanical construction of the instrument. Therefore, as an extension of the body, an instrument can, at most, be a good prosthesis. By removing the necessity of a physical object, the body becomes the instrument. But this in no way removes the need for motor skill and gestural control. In our software, at the time of this writing, the circa ten gesture prototypes we can clearly distinguish are: speeding up, slowing down, expanding, shrinking, steadiness, constancy of speed, collision, theatrical collision, smoothness, edginess. For exact definitions we refer the reader to our scientific papers on this topic.

Each gesture prototype can be mapped to a different subset of responding robots. In this respect, the study of Namuda gestures is quite similar to the study of any musical instrument. A certain level of fine motor control has to be developed in the player. Only once that level has been reached can the recognition software be modified by changing the parameters slightly. One would never buy a new and better violin for a child every time it makes a handling and playing mistake. Only once it knows the basics reasonably well should buying a better instrument become an option. Fortunately, in the case of the invisible instrument, we do not have to buy a new instrument but we can improve the software and adapt it to the player. This last possibility opens a whole new perspective for future developments in instrument building.

As said, the development of the invisible instrument, both in hardware and software, during the last 25 years ran in parallel with the design and the construction of the robots that make up the robot orchestra, today consisting of 60 robots. The robot orchestra basically consists of two categories of automated musical instruments: at the one hand we have novel sound sources and noise makers and at the other, existing musical instruments that we attempted to automate as fully as possible including many extended possibilities hitherto unimaginable to achieve from the same instruments when played by humans. Classified along organological criteria, this is an inventary listing of the entire robot orchestra as of today:

Pipe-organ robots using flue pipes:

- Piperola (a flute register with some added small percussion, 1996/2005)
- Bourdonola (a bass register with large wooden pipes, 1998-2005)
- Puff (a novel quartertone air-puff driven organ, 2004/2010)
- Qt (quartertone organ with a six octave range, 2005-2007)
- Bomi (closed wood pipes and conical valves, 2009/2010)

- Pos (holpijp register, 2018)

Pipe-organ robots using single-reed pipes:

- Vox humanola (vox humana register with castagnets, 1995/2005)

- Trump (trumpet register, 1999-2004)
- Krum (krumhorn register, 2005/2006)

Pipe-organ robots using membrane driven pipes:

- Klaks (an assembly of compressed air ship and car horns, under construction)
- Hybr (hybrid electroacoustic organ using membrane driven pipes, 2014/2015)

- HybrHi

- HybrLo

- C:\LogosWebsite\instrum_gwr\pi.html

Reed organs:

- Harma (harmonium, 2000/2005)
- Ake (accordion-robot, 2004-2008)
- Bako (bass accordion, 2006/2007)
- Melauton (melodica, 1991/2017)
  Harmo (large-scale harmonium, 2009/2010)

Cavity resonator driven pipes:

- Whisper (cavity resonators with some added percussion, 2013)

Tuned percussion robots:

- Klung (automated brass angklung, 1998)
- Vibi (automated vibraphone, 2001)
- Xy (automated quarter-tone xylophone, 2007)
- Tubi (automated quarter-tone tubophone, 2003/2005)

Robotic bells:

- Belly (automated mini carillon, 2002/6)
- Llor (automated stainless steel shells, 2004/2005)
- Vacca (48 automated cowbells, 2005)
- Vitello (36 automated cowbells, 2006)
  Tinti

Plate driven percussion robots:

- ThunderWood (intonarumori robot with nature sounds, 2000/2006)
- Flex – automated singing saws, 2002/2003)
- Psch (12 small thundersheets, 2006)
- Simba (cymbal robot, 2007)
- Ribby (ribbon-string instrument, 2011/201x – under construction)

Rod and spring driven percussion robot:

- Toypi (automated chromatic toy piano, 2008)
- Rodo (31 bronze rods, 2014)
- Springers (very large and long springs as well as a large siren)
- Chi (wind chimes with ultrasonic demodulation, 2016)
- Rumo (noise robot, 2014)

Wooden percussion robots:

- Casta Uno(15 castagnets, 2004, integrated in Vox Humanola)
- Casta Due (16 castagnets, 2007)
- Temblo (12 templeblocks and ratchet, 2013)
- a set of woodblocks is also integrated in Thunderwood.

Drum robots:

- Rotomoton (automated rototoms, 2000-2007)
- Troms (drum robot , 2000/2004)
- Snar (automated snaredrum, 2006)
- Hat (hit anything robot made to the order of Aphex Twin, 2009)
- Snar_2 ('Robosnare', automated snaredrum ordered by Aphex Twin, 2014)

Piano-robots:

- Player piano (piano robot #1, 1994)
- PP2 (piano robot #2, with pedal, 2005)

Robotic bowed string instruments:

Hurdy (dual stringed bass hurdy gurdy, 2004/2007)

- Aeio (aeolian cello, 2007-2011)
- Synchrochord (fretted monochord with synchronous excitation, 2011/2014)

Robotic plucked string instruments:

- Spiro (automated spinet, 2011)
- Zi (plucked zither or Qanun, 2014, under construction)

Robot brass instruments:

- So (sousaphone robot, 2003-2007)
- Bono (automated valve trombone, 2007-2010)
- Heli (automated helicon, 2007-2008)
- Korn (automated cornet, 2008-2010)
- Horny (automated horn, 2013)
- Bug (automated fluegelhorn, 2017)

Robot single reed wind instruments:

- Autosax (saxophone robot, 1989-2009)
- Klar (automated alto clarinet, 2012)
- Asa (automated alto saxophone, 2013)

Robot double reed wind instruments:

- Ob (automated oboe, 2008-2010)
- Fa (automated bassoon, 2009 - 2012)

Siren robots:

- Sire (24 automated sirens, 2005)
- Balsi (large siren, 2018)

Dripping robot:

- Dripper (a rain and dripping robot, 2002/2005)

Conducting robots and tools:

- Polymetronoom (conducting machine, 1969/1994/2012)
- Saf (mains isolated power supply unit for the entire orchestra, 2013)
- Display (two programmable displays, 2014)

As all gesture controlled uses of the robot orchestra require the performers to be naked, we were dreaming for a long time of devoting a book to the idea of 'robodies'. Each of our robots would be photographed together with a human nude, not a photo model. Nudity has always been an important bias in my artistic work, not only for its functional necessity, but also ideologically. All robots are designed by me to be naked, that is, readable in all respects. None of the components are hidden nor boxed but very much on purpose fully exposed to sight. All their functionality is thus revealed to a maximum extend, even if this makes them slightly more vulnerable.

On the pages following, the reader will find, side by side, a single page description of one of the robots as well as a picture of that robot in relation to a human nude. For the present publication we left out all technical details, design considerations, circuit drawings, maintenance instructions and guidelines as these are available in full on the Logos website.

We express our thanks to all people that helped us out to realize this project. As we do not want to tag the people individually in the pictures, we name them here as a group: Dominica Eyckmans, Emilie De Vlam, Marjolijn Zwakman, Moniek Darge, Angela Rawlings, Sebastian Bradt, Zam Martino Ebale, Andrea Urbankova.