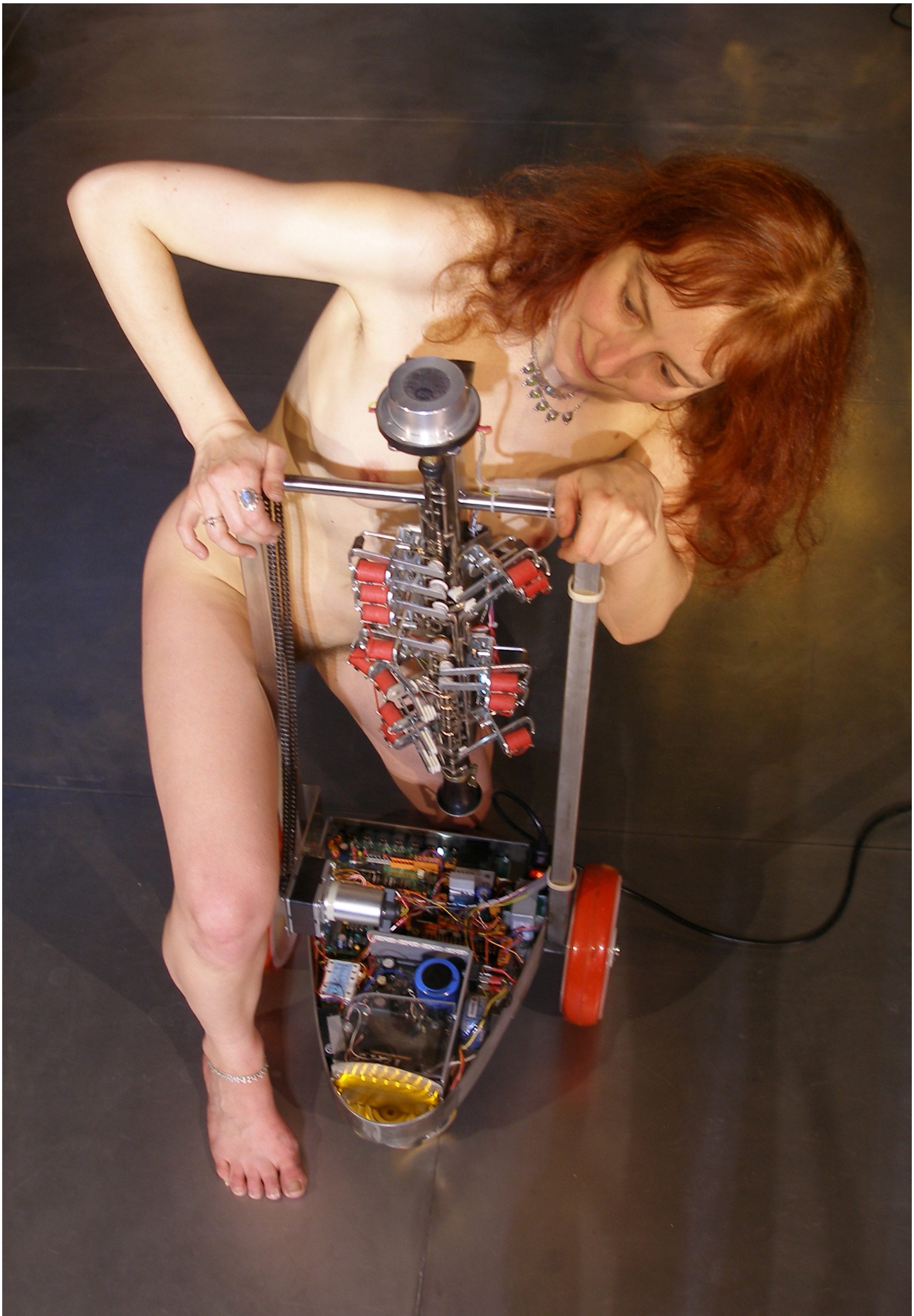
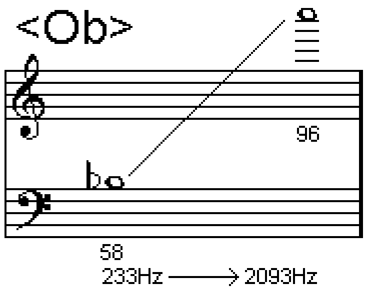


<Ob>

This musical robot belongs to the category of our automated classical music instruments: the oboe. The approach here was quite experimental and was an attempt to realistically automate an existing unmodified instrument, and thus it does in fact make use of a fine classical oboe. The instrument used is a Brussels made concert instrument by F.Debert, probably to be dated first half of the 20th century. Electromechanical control of the levers did not confront us with any real problems apart from the quite delicate and differentiated mechanics. Silent operation of these have been our main concern. We simplified the fingerings such that we could suffice with less than 16 solenoids: six closing the open holes, and the strict minimum of seven for the essential levers. Some of the levers (such as the three octaving levers as well as the levers to facilitate trills) are essential for players, but have much less importance in an automated instrument where the attack of the tone is guaranteed by the nature of the sound mechanism and where resonance on partials can freely be used. Alternative fingerings in order to obtain different sound colors are implemented as well.
The double reed however, became the main problem. The first experiments conducted us to the design and building of double reeds made from piezoelectric material glued to brass plates. We got a few prototypes build along this line, up and working and indeed the concept is workable. The main problem here was the very low obtainable sound pressure, even when driving the piezo-material well above its rated maximum voltage (35 V). The second series of experiments was carried out using a double faced piece of piezoceramic bonded to a central brass plate and placed just touching to an absolutely flat thick brass plate with a central perforation of 4.2 mm. This mechanism gives a strong buzz but unfortunately, sound production is very frequency dependent as well as dependent on applied air pressure (after placing the assembly in a closed container). A secondary problem in this approach was the noise generated by the compressor. We used a small DC motor driven vacuum cleaner type compressor capable of producing the required pressure of about 15 to 30 mBar. Therefore a thirth series of experiments was carried out using tweeter motor driver made for driving an exponential horn. Instead of coupling the driver to an exponential horn, we designed an acoustic impedance converter modeled after a real reed in a human mouth cavity. This piece had to be fabricated on the lathe. With this mechanism, the realism of the produced sound becomes highly dependent on the waveform applied to the driver. Something trapezoidal seems to work best. However, in order to come close to original oboe sound, articulation is very essential: frequency modulation, phase modulation of at least the first two partials above the fundamental as well as some amplitude modulation (envelope shaping). The circuit for driving this motor was derived from the circuits designed earlier for robots such as <Korn>, <Bono> and <Aeio>. It uses the same PC-board and the same PIC microcontroller. The firmware however, is quite different. For coupling of the circuit to the motor driver, we use a classical audio output transformer. The two resistors and a capacitor form a simple formant filter tuned together with the inductance of the transformer, to the required strongest formant frequency for oboe sound.
As an extra feature, we suspended the entire automated oboe construction in a cradle. Thus the instrument has freedom to move in different inclinations. The axis of suspension is provided with a dented wheel driven by a chain and a motor with reduction gears. This way, any inclination can be held and controlled. The movement possibility was added since it mimics a bit the behavior of a human oboist. In the software we use for controlling the automate, we are implementing rules such that the robot derives its gestural behavior from the music it gets to play. The circuit secures that the instrument is not allowed to turn fully around, since that would ruin the robot. Movement is limited to an angle of ca. 90 degrees. For the sensor, we decided to call in an analog tilt sensor by Penny & Giles allowing us the read the position of the instrument at all times using an analog input port on the PIC controller. For the motor control we made use of a Trident 4-quadrant DC motor controller.

Note range:


<Ob>
96
58
233Hz
2093Hz