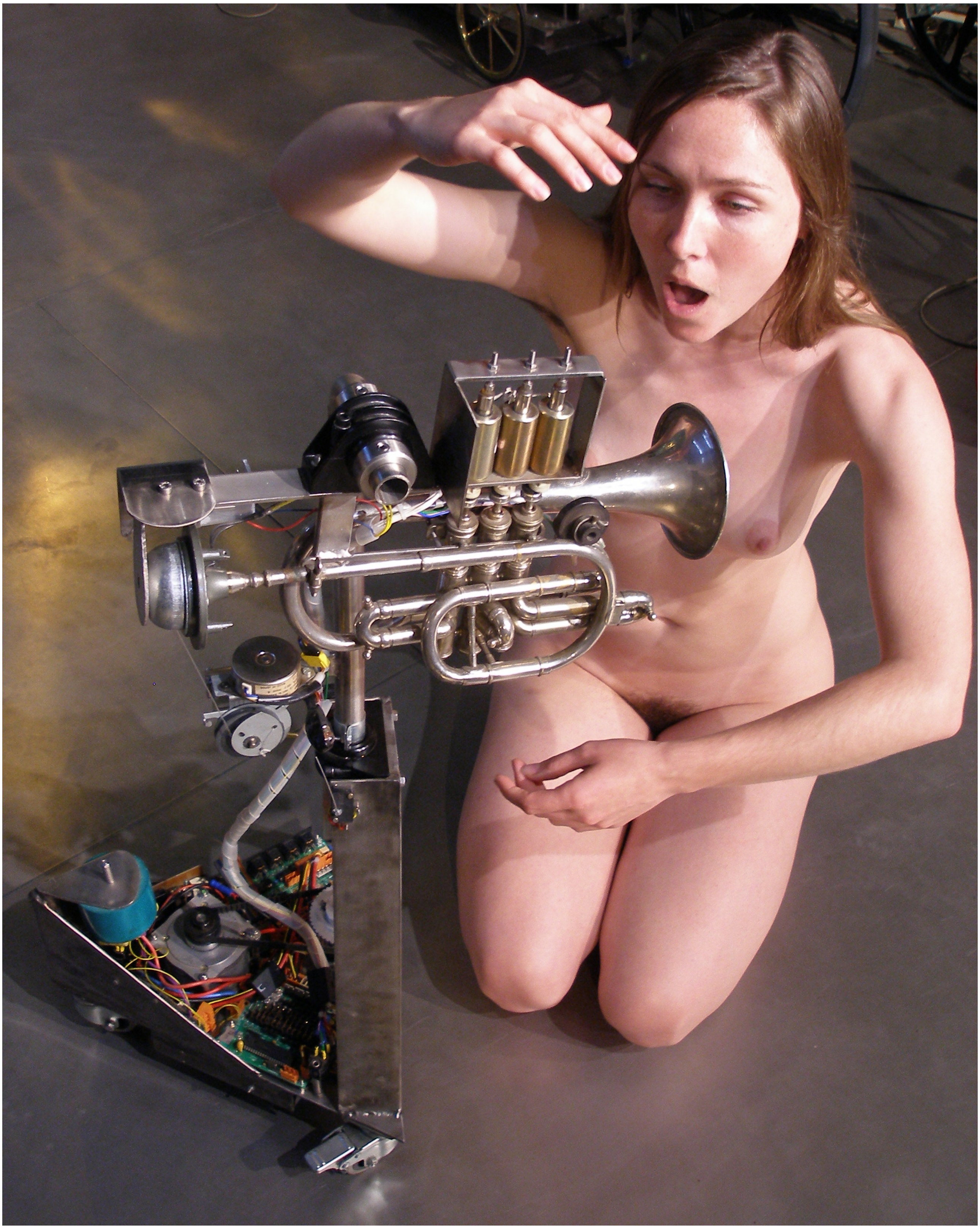

# <Korn>

This musical robot was the result of our first experiments with membrane compressor driven sound production on brass instruments. It does in fact make use of an old Bb cornet and the attempt was to get a realistic cornet sound. The driver causes resonance in the cornet tubing, but in this case there is no real one-directional windflow through the instrument, but rather a standing wave. When a note is requested from the cornet, the firmware will calculate the optimum valve combination -including non orthodox fingerings- for the requested pitch. Microtonal pitches are implemented such that the instrument is capable of performing quartertone music, as well as a wide range of different tunings and temperaments with great perfection. The relatively low Q-factor of the horn (compared to strings...) as an acoustic resonator renders this very well possible. The signal generated in the motor was shaped after a physical model of the air pressure waveform in the mouth cavity of a player. Since there is no loop coupling from the resonator to the generator, the sound generation mechanism is a hybrid somewhere between synthetic/electronic and natural/acoustic. The advantage being that the reliability of the robot becomes very high, but this is obtained at the detriment of some realism.

The valves are used in this instrument to tune the fundamental frequency of the instrument. The valves can be controlled independently from the mouth driver frequency. They are mechanically driven by unipolar solenoids  and have a return spring. Bi-directional solenoids would have been superior (read, faster and more silent in operation due to the absence of return springs) but we just did not have enough mounting space in this rather small instrument.

High brass instruments in their normal human biotopes tend to move quite a bit in space. The highly directional characteristic of these instruments make this also an expressive valuable parameter. Thus we tried to implement movement in two degrees of freedom in this robot: the cornet can be tilted in the vertical plane over an angle of about 90 degrees and in the horizontal plane, it can rotate over 180 degrees. This conforms pretty well to what human players do in terms of movement on stage. The movements cannot be very fast however, at least not much faster than what a real cornet player could do whilst playing. Horizontal movement is a lot faster than the vertical movement. However, the intention never was to render Doppler effects possible...

The electronic circuitry consists of four printed circuit boards:

1. Midi-hub board: This board, using a Microchip 18F2520 controller, takes care of the Midi I/O handling and communication as well as the control of some of the the lights and the movement of the horizontal movement stepping motor, including the two end sensors. For these we used two Pepperl & Fuchs inductive proximity sensors. Provisions were also made for two PIR-sensors allowing the robot to 'search' in space for moving human bodies.

2. Horizontal stepping motor driver board using a Nanotec SMC42 compact microstep constant current driver.  This motor is designed for 360 steps for a complete rotation.

3. Pulse & Hold board: This board steers the three solenoids for the pistons as well as the vertical movement stepping motor and the lights.

4. Sound generator board: This board, using a microchip ds-PIC 30F3010, steers the 15 Watt motor compressor horn driver. Note that the output transformer forms a tuned circuit, tuned to the formant band of the cornet (1.8 kHz). The transformer at high sound pressure levels, operates close to saturation, thus causing a formant shift upwards. When a coil gets into saturation the inductance decreases. This clearly nonlinear behavior of the circuit was part of the design.