# Giorgio Facco

# NEUROLAB 2008 in Ferrara [ http://web.unife.it/progetti/neurolab/ ]

I have worked in NEUROLAB in Ferrara with Prof. Luciano Fadiga, Dott. Oliynyk Andriy, Dott.ssa Luana Caselli.
In this period I worked in Electrophisiology laboratory employing primates (Macaca fascicularis) as animal models, the goal of our research is to shed more light on the nature of the sensory-motor response of neurons in the premotor cortex of the monkey and the plasticity of that during the performance of a specific motor task (ie grasping, holding, handling) and to record the activity from F5 and F4 areas while the monkey will be engaged in executing motor-task.
In this year I have been learning the use of the following experimental instruments:

- PILine® Piezo Motor technologies to do single-unit recordings, to control movements of the electrodes with µm precision.
- Tucker-Davis Technologies (TDT) software and hardware (Preamplifier, Amplifier, headstage).
- Rinocheros to design implantation chamber for rats.

Below you can find a more exhaustive explanation of my works in 2008.

The main aspects considered in my work are the following:

| (1) Human | (2) Monkey | (3) Rat |
|---|---|---|
| | | |
| **(a)** Setup for multi-electrodes recordings | **(a)** Electrodes | **(a)** Rendering and creation of recording array chamber |
| **(b)** Tucker-Davis Technologies (TDT) systems technologies | **(b)** Controller for PILine RodDrive M-674.164 | |
| | **(c)** Monkey Training | |
| | **(d)** Monkey's brain mapping | |
| | **(e)** Project of new setup for Optical encoder | |

**(1a)**

This setup is needed to do single-unit recordings in human patients at the Neurosurgical Unit in Udine.

I worked on the setup, the connections and the software to be modified according to our necessities.

The setup is composed of :

- P-661 PILine® OEM Piezo Linear Motor **[** http://www.physikinstrumente.com **]**
- C-865.161 Single-Axis PILine® Ultrasonic Piezomotor Controller/Driver
- Preamplifier and Amplifier made by Politecnico di Milano
- Software for Piezomotor P-661 control and Data Acquisition and Visualization

**(1b)**

I have been learning to use a multi-channel Tucker-Davis Technologies (TDT) system in all of its components, software and hardware. **[** http://www.tdt.com/ **]**

The TDT system is composed of:

1. **TDT Hardware**

   - Amplifier : RZ2 Z-Series Base Station
   - Preamplifier: PZ2 128-Channel PreAmp
   - Headstages:

     - High Impedance Headstages 2 x 64-Channel Acute Headstages NN64AC
     - Low Impedance Headstages 4 x 16-Channel Headstages

2. **TDT Software**

   - OpenEx
   - OpenDeveloper
   - OpenExplorer
   - SpikePac

Then I had to make a new connector for utilizing the TDT High Impedance Headstages for Epicortical recordings in humans. For this, I used the Samtec Header MOLC.

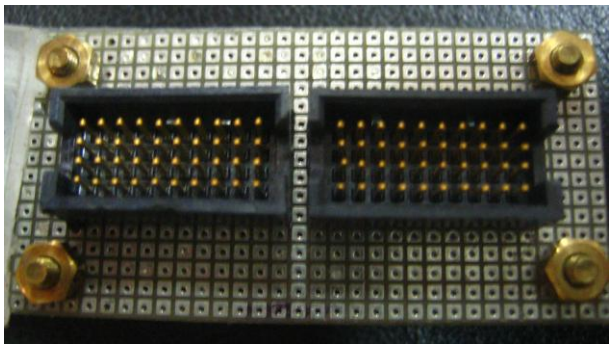

**Figure 1 Connector for Epicocortical Recordings Front view**

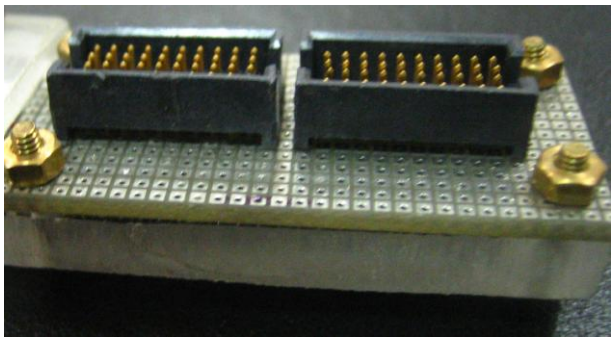

**Figure 2 Side view**

## (2a)

I learned how to produce tungsten electrodes for Monkey single-unit recordings. The desired tip of the electrodes was achieved by a electrolytic process and the correct impedance was obtained by covering the electrodes with SIVAMID paint.

## (2b)

For the monkey setup we needed a stand-alone controller for the movement along the z-axis of M-674.164 PILine RodDrive. So, I created a variable square wave Generator that is able to control specific motor steps.

This controller has 5 steps (1µm, 10 µm, 50 µm, 0.2 mm, 1 mm, 2mm) that were decided according to our needs.

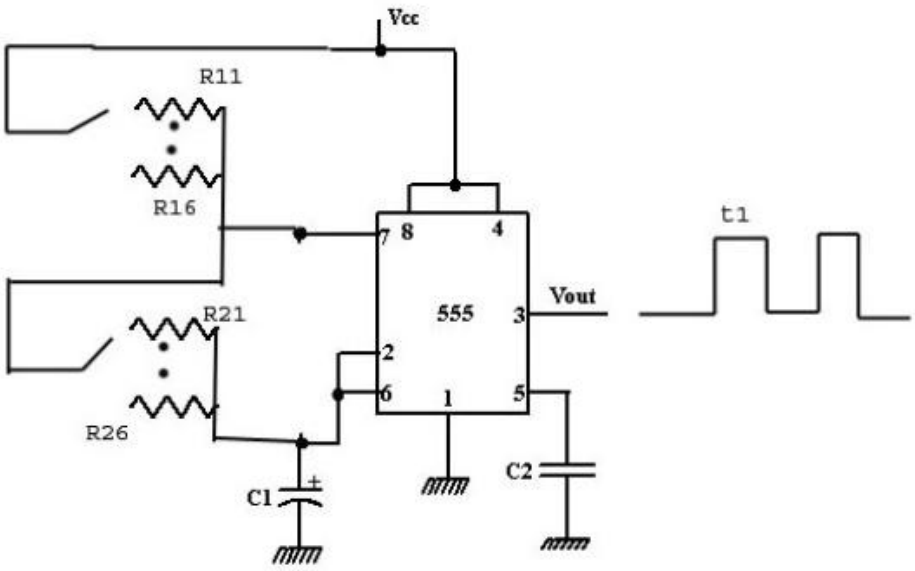


**Figure 3 Circuit of Multi Square wave Generator to control the movement of M-674.164 PILine RodDrive**

Then this circuit was inserted within a box with C-184.D64 PILine Analog OEM Drive Electronics for PILine RodDrive M-674.164. This can be considered as a complete system to manage the Piezo-motor M-674.164.


**Figure 4 Finished Box for Piezo-motor M-674.164 control**


**Figure 5 Finished Box**

**(2c)**

In the first months I just took confidence with animals, I learned the procedure to take them out of the cage in a safe way and to put them on the primate chair. I also learned how to clean the implanted recording chamber, a procedure that takes place at the beginning of each recording session. Then I began to train the monkey to perform different motor tasks necessary for our experiment.

**(2d)**

We have started to map (every day) the monkey's motor cortex accessible through the recording chamber. The aim of this mapping is to know the exact location of areas F5 and F4, which are the target brain regions of our experiment.

**(2e)**

As we wanted to have a better setup to know the position (in depth) of the electrode in the cortex we have applied a magnetic sensor (SS490 series Miniature Ratiometric Linear) to the piezomotor. However, that was not very precise, so that we decided to replace it by a new Optical encoder (Numerik Jena Lik 21).

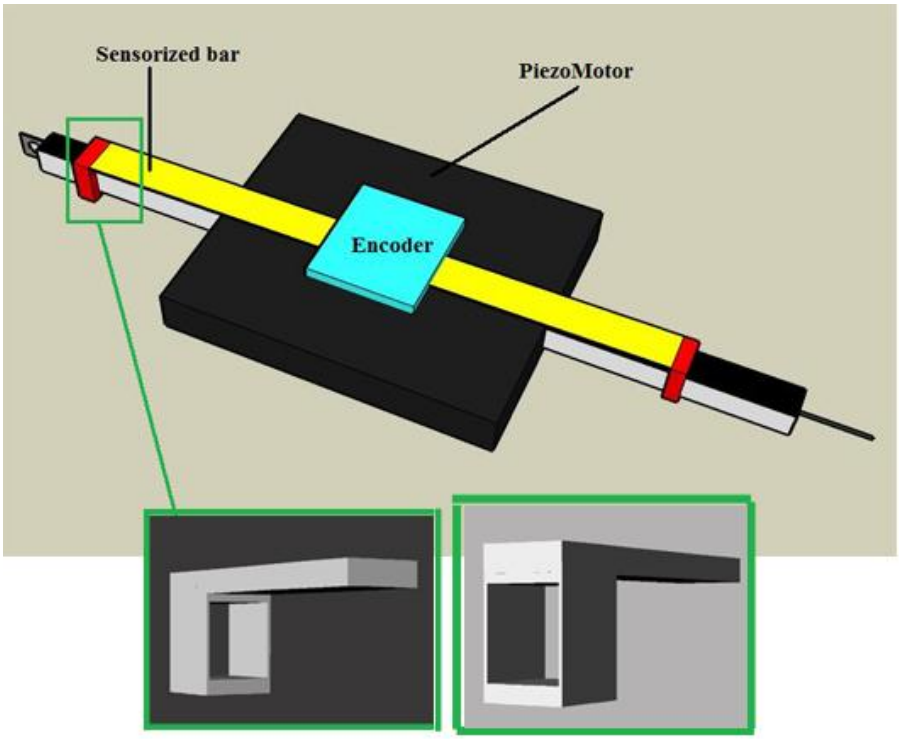


**Figure 6 Project of setup for Optic Encoder with M-674.164 PILine RodDrive Made with *Google Sketchup & Rinocheros* software**

**(3a)**

Another experiment in which I am involved is the investigation of the mirror neuron system in rats. To this purpose, we created a Plexiglas box with two rooms, one for the rat that will watch and that will have the chronic implant and another one for hosting the acting rat that will be trained in performing a movement (i.e., eating).

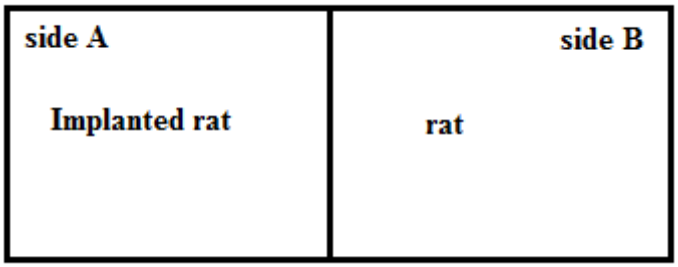


**Figure 7 Plexiglas box**

Then I designed the chamber for the recording array by means of *Rinocheros* software. By a plotter we created it.

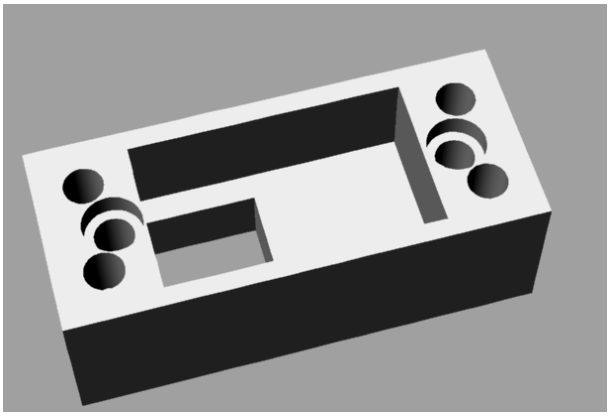

**Figure 8 Recording array chamber Rendering 3D made with Rinocheros**

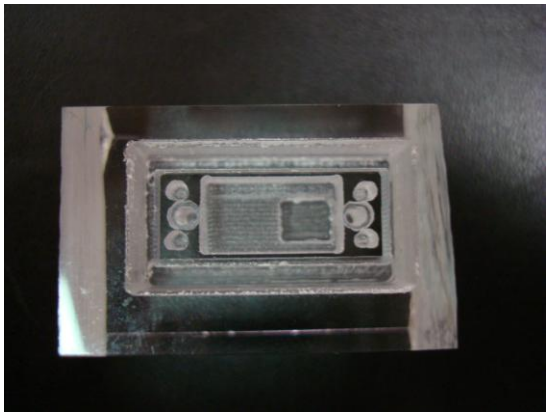

**Figure 9 Recording array chamber Top view**

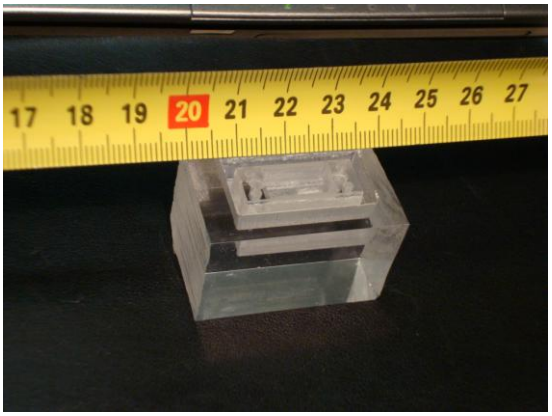


**Figure 10 Recording array chamber Side view**

**Figure 11 Finished Recording array chamber**