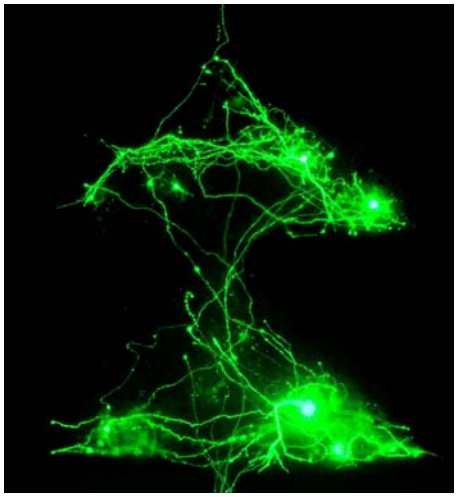
Assaf Rotem - Research Description

In my PhD, I worked with networks of neurons taken from fetal rat brains and cultured in the lab. When grown on 2D substrates, these networks are very large (almost a million cells), very complicated and hard to monitor and control; but, by using a technique developed in our lab we can now grow these networks on patterns designed at will and thus control global connectivity, size and geometry of the network. We used this method in two ways. One was designing patterns that resulted in a functional neural network that responded as thresholds, AND gates or Diodes. The other was mimicking the structure of cortical axonal pathways to achieve the first magnetic stimulation of dissociated brains.

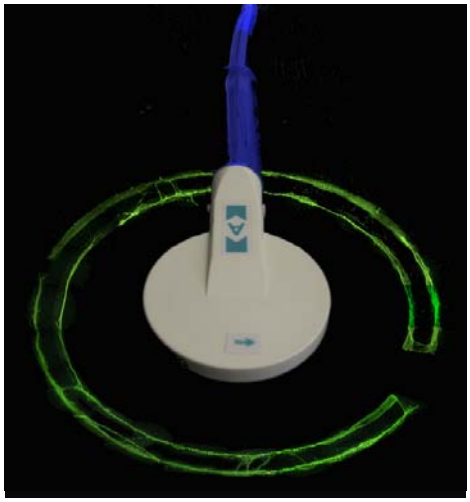
From neuronal devices we learn of connectivity between neurons – how often and how far do axons travel between neuronal ensembles, and how many neurons are needed to communicate between ensembles of neurons. Mimicking brain structures taught us about the factors that enable and enhance magnetic stimulation in-vitro or in the human brain: collective directionality, geometry and electrophysiological properties.

During this period I became a fan of experimental biophysics. The act of designing and setting up an experiment, taking and analyzing data and eventually making sense of it is ever so enjoyable (or frustrating), challenging and hopefully essential when the system is alive. I am now searching for one such fascinating question.

In addition, I gained experience in setting up hardware (optics, lasers, video imaging, magnetic and electric stimulators), connecting it to software (Labview) taking data from human brains (EEG), live or dissected animals and analyzing it (Matlab).



Neuronal Diode: neurons grown on triangular patterns break the symmetry of transmission, preferring upward propagating signals.



A culture of hippocampal neurons grown on rings 25mm in diameter, which respond to magnetic excitation.