2. Culturing and modeling for parameters in Deep Brain Stimulation.

E.Marani[1, 2], T.Heida[1], J.Stegenga[1], J. Lefeber[1], K.G. Usunoff[2, 3]
1) Dept. Biomedical Signals and Systems, BMTI, Faculty EWI, Twente University Enschede, The Netherlands
2) Dept. Anatomy and Histology, Medical University Sofia, and
3) Inst. Physiology, Bulgarian Academy of Sciences, Sofia, Bulgaria.

Deep Brain Stimulation (DBS) parameters are set by trial and error. Moreover, DBS produces non-selective stimulation of an unknown group of neuronal elements over an unknown volume of tissue by this high frequency stimulation.
By culturing rat subthalamic neurons (STN) on multi-electrode arrays (MEA) flat unorganized neuronal cultures are produced. MEA produce the possibility to stimulate and to record from these neurons.
Addition of acetylcholine produces a reduction of direct activity and a decrease of the frequency of action potentials over time. High frequency stimulation reduces the frequency, even after the stimulation period.
The introduction of the definitions phase profiles and burst profiles makes it possible to follow the action potentials on separate electrodes (phase profiles), while the action potential activity over all electrodes (burst profiles) demonstrates the activity of the whole network. In general the activity tends to group in the same way over each electrode and all electrodes, indicating a return to a conservative pattern of activity after nearly twenty days of culture.
Using the conditional firing probability strength and delay of the connections can be studied, being a predictor for connections that will increase in strength if their delay is short.
These results are compared to the outcome of single cell, network and system models that are partially present in literature and partially newly developed within our Biomedical Signal and Systems group.
The outcome of this research is compared to the human connections and activities present in Man after DBS in order to predict parameter settings for DBS.