

## Action potential rate analysis in responses produced by insect olfactory receptor neurons

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In the analysis of biological functions of insects, such as responses of olfactory receptor neurons (ORNs) of their antennae, it is important to distinguish delicately action potentials (APs) generated by individual neurons in the spot of the measurement and also by the other active neurons in the close vicinity of that ORN. For attaining good results the odor exposure must be delivered towards the ORN of an interest which must be exposed and controlled for a long time enough. In order to understand the details in the odor sensation it must be taken into account that the resulting information at odor exposure can be obtained from single cell recordings in which there are one or two active cells.

Each AP can be separated at most from three different sources in *off-line* analysis and the AP rates can be classified into three groups depending on the shape of APs. However, a separation into two classes could be successful enough in practice. The classified APs can be stored for further analysis and printed for documentation. A multi spike detector (MSD) collects the data of action potentials either *on-line* or *off-line*. The latter is easier to carry out. If a source of the data is very unique, it is important to store all the data before doing the analysis. In both *on-line* and *off-line* analysis the incoming signal is continuously monitored by MSD which detects and sorts the APs in real-time [1]. When the best fit to the measured AP and its template is reached, the detector reports this event both to the host PC and to an external instrument, for example to a time to voltage converter (TVC).

In MSD, the detection and assorting are simultaneous in a single measurement channel. The measurement is then directed to each corresponding channel where a single action potential shape represents an individual ORN. It is possible to determine the interspike interval periods or action potential firing rates for each receptor neuron. The match between the AP and its template is found, when the local minimum of the sum of squared deviations between the template and AP is within the given criteria limit. This event is called a detection.

We have reported elsewhere several aspects of the AP responses to the odour exposures of individual olfactory receptor neurons [2]. Shortly, AP data were obtained from blowflies (*Calliphora vicina*), mosquitoes (*Culex pipiens*), fruitflies (*Drosophila virilis*), and homefly (*Musca domestica*). Many studies of AP discharge require the isolation of the AP generated by each single ORN. The on-line peak detection method described in this presentation facilitates the characterization of firing patterns during the recording of AP activity in ORNs, for example. It is easy to extract information about the occurrence of APs from single cell sources. However, insect olfactory sensillae contain many ORNs, so it is difficult to extract all the information about the occurrence of APs of insect ORNs. Unlike other common techniques, the MSD method is user-friendly, economic, fast and its parameters are defined quantitatively in real time. In the exposed ORNs the AP shape and waveform changes very much which causes difficulties in MSD analysis. Therefore, we have analysed these responses by TVC published in [2].

### REFERENCES

[1] MSD Multi-Spike Detector User's Manual Version 3.20, Alpha Omega Engineering, Biomedical Division, Nazareth, Israel.

[2] Matti Huotari, Biosensing by insect olfactory receptor neurons, Sensors and Actuators B 71, 212-222, 2000.