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Customized Intelligent Life-Inspired Arrays

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DELIVERABLE: D2.2.6 – Executive Summary

**RECEPTIVE FIELD PROPERTIES OF BRAINSTEM
LATERAL LINE NEURONS IN RESPONSE TO
DIPOLE STIMULI**

Actual submission date:	February 28, 2008	
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EXECUTIVE SUMMARY

Theoretical data suggest that information on the position of a vibrating source can be derived from the excitation pattern of pressure gradients distributed along the lateral line (Curcio-Blake and van Netten 2006). The theoretical predictions were confirmed by neurophysiologic experiments performed on single fibres in the posterior lateral line nerve of goldfish, demonstrating that the location and separation of peaks and troughs in the neuronal responses change in a predictable way with location and vibration angle of a dipole, i.e., sinusoidally vibrating sphere (c.f. D2.1.4).

If a central neuron would analyze inputs from an array of peripheral receptors such that it encodes for these peaks and/or troughs, then this neuron would directly encode for object location. We searched for such neurons at the first site of central integration in the fish brainstem, the medial octavolateralis nucleus (MON). In analogy to our studies on the peripheral lateral line, we systematically investigated receptive field properties of brainstem neurons with a sinusoidally vibrating sphere. Spike activity evoked by the sphere was recorded as function of sphere location alongside the fish and different angles of sphere vibration (0° =parallel to the fish, 90° =perpendicular to the fish, 45° and 135°).

The data show that different MON neurons can exhibit quite different receptive field shapes. Moreover, most receptive field types were different from those described for primary afferent fibres. We found receptive fields that consisted of single excitatory or inhibitory areas that could be fairly narrow or extend across large parts of the body surface, whereas the receptive fields of other neurons consisted of two or even more excitatory or inhibitory areas.

The overall shapes of the receptive fields were more or less the same for different sphere vibration directions. Nevertheless, in most MON neurons receptive fields changed in some aspect when sphere vibration direction was altered. However, the changes were not consistent across neurons and not predictable as those described for primary afferent fibres. Frequently, these changes consisted of shifts of the receptive field borders along the rostro-caudal axis of the fish. In some neurons number or location of the response peaks changed. Neurons with a clear preference for a distinct direction of sphere vibration, i.e., neurons that responded only to a particular vibration direction were not found.

In summary, our data show that there can be effects of sphere vibration angle on shape and size of receptive fields of lateral line neurons in the fish brainstem. This means that these neurons maintain the possibility to encode source location and source vibration direction. However, MON neurons apparently do not encode pressure gradient patterns in the same way as primary lateral line afferent fibres.