Neuroscience data talk

Rotational neural dynamics in the spinal cord and a new theory of movement

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Host: Tim Vogels

Most of the investigations on spinal rhythm generation are based on motor nerve recordings and single neuron recordings. Since flexor/extensor muscles alternate during movements, it is often assumed that the generation is accomplished by neuronal modules that alternate in opposition, which single neuron recordings seem to support. However, here we argue that when many neurons are monitored simultaneously a different picture emerges. We recorded hundreds of neurons from the lumbar spinal cord of turtles and rats during rhythmic movement (walking and scratching) and found that, rather than alternating, the neuronal population is performing a "rotation", i.e. cycling continuously through all phases. Rotational dynamics are observed across trials as well as behaviors. Since such rotation is difficult to explain with existing models of alternating neuronal groups, we propose a new theory that accounts for the rotational dynamics. Using a simplified network model, we show that in spinal networks with recurrent excitatory and inhibitory connectivity, there is no need for pacemaker activity, CPG-layers or modular structures. Tonic input to the network controls the rhythm and pattern depending on the task. The model also reproduces other experimental observations and provides a mechanism for multifunctionality. To further investigate spinal circuits, we investigate the modulatory effects of the brain (Pedunculopontine nucleus) on the spinal population activity during the volitional locomotion of the rat.Short bio:Rune got his master degree in physics and biophysics at University of Copenhagen, after which he went to graduate school to work with Professor David Kleinfeld at University of California, San Diego, where he work on the motor control of the whiskers of rodents. In 2003-4, after 6 years with David at UCSD, he did a short post doc at the Veterans hospital in Taipei in Taiwan, working with spinal cord injury with Professor Henrich Cheng. Then in 2004 he went back to University of Copenhagen to work with Hounsgaard doing a post doc on single intracellular recordings from spinal neurons in turtles. In 2008 he started forming his own lab and in 2013 he became tenured associate professor at the Department of Neuroscience. His research focus is a network approach to understand the nervous system, especially the motor system.https://scholar.google.com/citations?user=x1QHxIUAAAAJ&hl=en

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Office Bldg West / Ground floor / Heinzel Seminar Room (I21.EG.101)

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