

Self-Organization - Guided and Guiding

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Self-organizing control enables autonomous robots to perform exploratory behaviors that establish efficient sensorimotor interaction, coordination of movements and the generation of a behavioral repertoire. Since the temporal sequence of the primitive actions is usually hard to predict for an external observer, such systems can not be used to achieve a goal or fulfill specific tasks.

With this in mind we show an application of guided self-organization using homeokinetic control [Der, 2001], where on the motor control level execution of a given reference signal is achieved. Interestingly, due to the homeokinetic principle the motor command generation is based on the (proprioceptive) sensory feedback. As a consequence, in abnormal conditions motor commands are decreased if they cannot be properly realized, hence decreasing the power unnecessarily enforced to the robot motors. This way the self-organized control guides the motor command execution.

The proposed system is applied to a physically realistic simulated legged robot where we use an oscillation generated by a central pattern generator (CPG) as a reference signal. In normal conditions the desired walking behavior can be realized. When colliding with an obstacle the motor command is drastically reduced to avoid unnecessary motor stress. However, there are no additional sensors, e.g. distance or foot-contact sensors, required. After the robot passed the obstacle the motor command synchronizes again to the reference oscillation and the robot continues its gait cycle, see figure 1.

This finding gives a glimpse on the potential inherent in self-organizing control approaches which can be exploited for goal oriented robot control by guiding mechanisms.

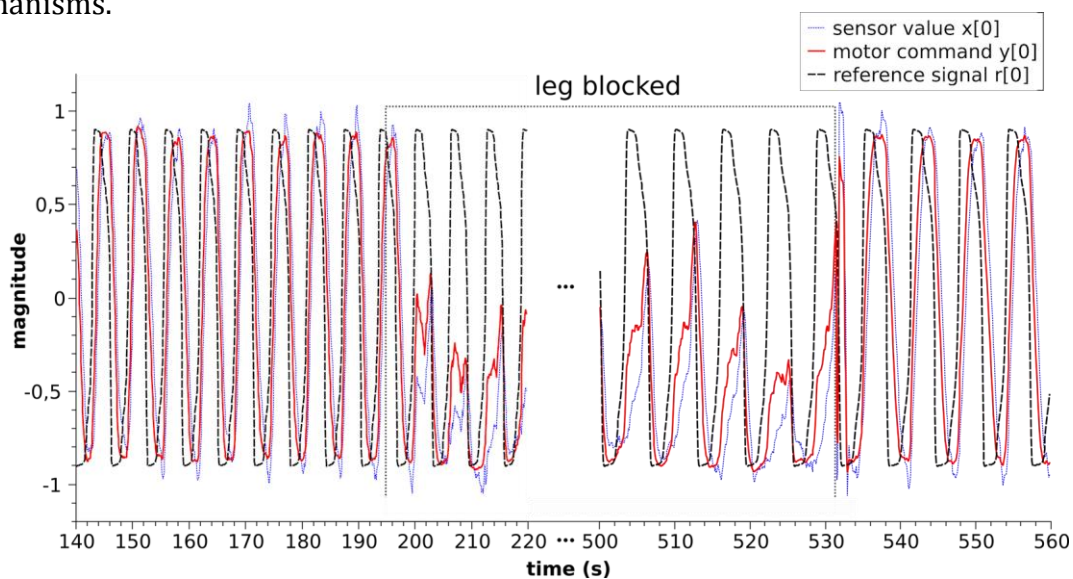


Figure 1: Sensor value from a joint angle sensor, motor command and reference signal (CPG) of one motor of a legged robot. While the leg is blocked by an obstacle the motor command is reduced, afterwards it follows again the reference signal.

References:

Der, Ralf. 2001. Self-organized acquisition of situated behaviors. *Theory in Biosciences* 120, no. 3-4: 179-187.