IBSS special seminar: Bio-inspired Engineering

Date: 15th October, 2018

Room: IBSS meeting room, 5th Floor Building 12

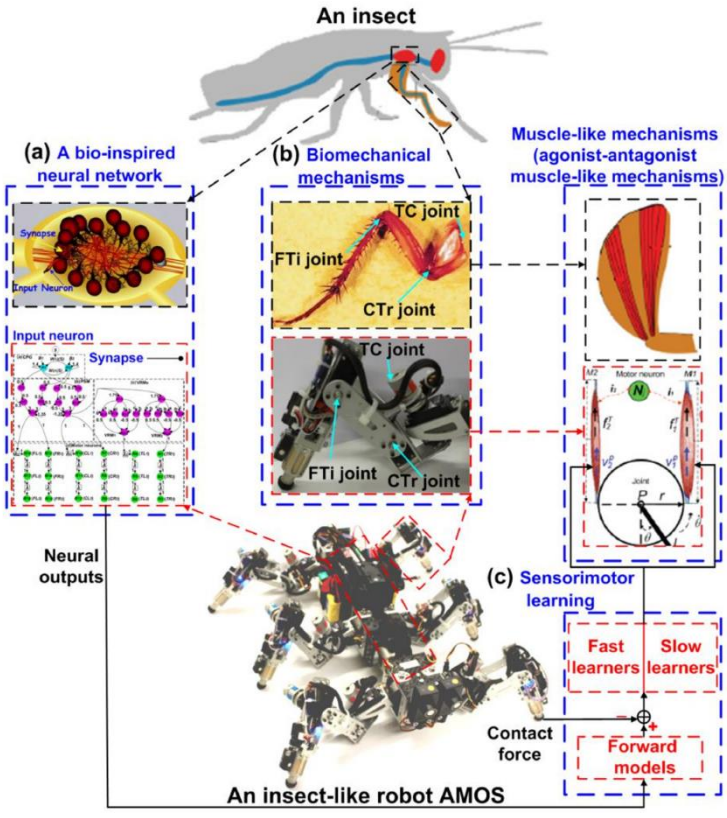
Program

8:30 – 9:00	Scalable Neuromechanical Control and Learning of Bio-inspired Movements, Xiaofeng Xiong (University of Southern Denmark)
9:00 – 9:30	Legged robots and novel adaptive CPG control, Mathias Thor (University of Southern Denmark)
9:30 – 10:30	IBSS research presentation
10:30-11:00	Discussion

Scalable Neuromechanical Control and Learning of Bio-inspired Movements

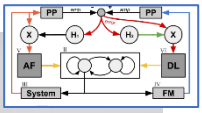
Xiaofeng Xiong (University of Southern Denmark)

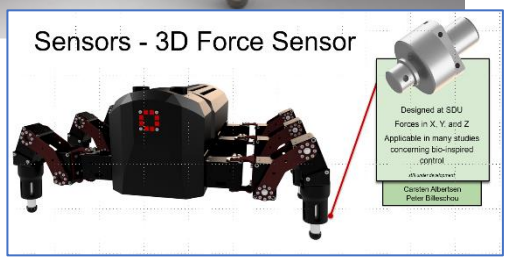
Abstract: The neuromuscular systems of humans and animals can produce versatile and efficient movements (e.g., walking) in dynamic and changing environments. Using embodied systems (i.e., robots) facilitates investigating and understanding control and learning principles of the neuromuscular systems. It helps for developing more robust and compact robots to meet societal ends, e.g., rescue or motor rehabilitation. The talk will focus on control and learning mechanisms of neuro-musculoskeletal models, which could scale from low (i.e., human arm manipulation) to high (e.g., insect-like walking) degrees-of-freedom (DOFs) movements.

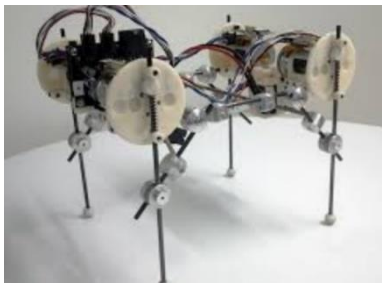


Legged robots and novel adaptive CPG control

Mathias Thor (University of Southern Denmark)







Abstract: Current solutions to adaptive locomotion for legged robots are promising, but often looks miserable and are far from able to compete with the behaviours of real animals. This is presumably due to fact that the many benefits of using legs most often are overshadowed by their high design complexity. In this talk, we will present the two robots LocoKit and MORF which both can be used in a wide range of studies. LocoKit is a robot construction kit optimized for building light-weight, dynamic robots. LocoKit provides a complete package for building your robot including mechanics, electronics, and software. MORF is a more robust robot which makes use of state-of-the-art components for high performance as well as kinematics inspired by nature. It is very sensor-rich and contains sensors such as joint position, joint acceleration, joint torque, 3D foot contact sensors, etc. MORF is modular as it defines standards that can be used for re-configuring, extending, and/or replacing parts of the robot, e.g. body shape. It does also, like LocoKit, provide a complete package with a software suite that contains a full simulation of MORF and hardware interface methods based on the Robot Operating System (ROS). Finally, we will present a novel error-based learning mechanism, called Dual Integral Learner (DIL), which can be used for adapting the frequency in Central Pattern Generators (CPGs). We will also introduce a method for combining the DIL mechanism with a correlation-based learning mechanism, called frequency adaption through fast dynamical coupling (AFDC), using a neural structure. Results show that our mechanisms are able to reduce the tracking error between the desired and actual movement of the joints in a simulated legged robot by adapting the CPG frequency. Reducing the tracking error also resulted in energy efficient locomotion. This, together with the simplicity of our mechanisms may provide significant improvements to research concerning adaptive gaits, trajectory optimization, universal controller, and other studies where intrinsic or extrinsic parameters change.