Comparison of synchronous and asynchronous control modes on dynamic control

R. Téllez, D. Pardo and C. Angulo
Technical University of Catalonia, Spain

We test and compare the synchronous and asynchronous control modes of the Urbi programming environment for the control of twelve joints of Aibo on a coordination task. This Urbi application was created when we developed a neurally based control program for the generation of walking gaits in Aibo.

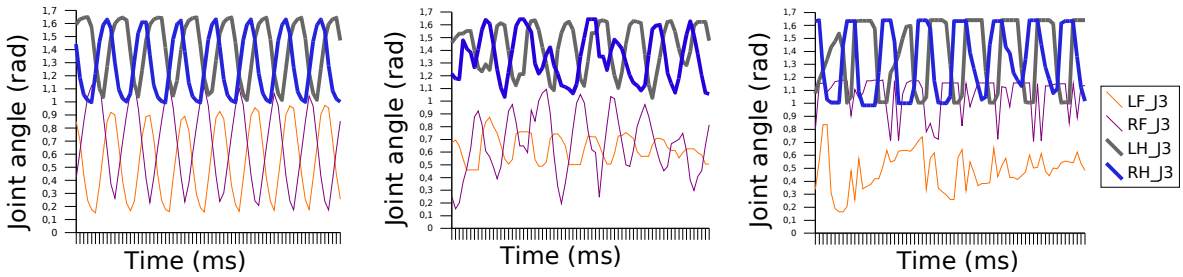
The control program is based on a set of twenty four Continuous Time Recurrent Neural Networks (CTRNN). Twelve CTRNNs are in charge of controlling one of the joints of the robot. At the same time, other twelve CTRNNs are in charge of controlling the twelve joint sensors. All the nets cooperate to control the robot and make it perform the task. Joints must oscillate in real time with a determined phase relationship, based on the walking gait that we want to reproduce.

Neural nets have been evolved on an Aibo simulator (Webots) to produce such oscillatory behavior and then transferred to an Urbi implementation of the control program, using libUrbi 0.9.

The reactive control loop works as follows: each 96 ms the state of the sensors involved in the control is updated. Their values fill the inputs of the sensors neural nets, and produce an output. That output is then used to input the motor neural nets, that produce the control signal for the motors.

We implemented the neural nets on a separated library and linked with the main program at compilation time.

We show how the synchronous mode is not capable of generating the correct joint trajectories in real time, while the asynchronous mode produces joint trajectories more similar to that obtained on the simulator. Comparison against the simulator is also provided.



Figures show the trajectories obtained for the four J3 joints of the Aibo robot. Graphics plot the results obtained on simulator, on real robot with Urbi in asynchronous control mode, and on real robot with Urbi on synchronous mode, respectively