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Autonomous robotics

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Exercise 7 Timing

Read the review article "Timing, Clocks, and Dynamical Systems" by Schöner (*Brain and Cognition* 2002, the paper is available as a pdf download on the course web page). You can safely drop section 3.1.

1. Examine the "Amari oscillator" of Equations (6) and (7). Analyze this dynamics in the approximation in which the sigmoid function is a step function. For each of the four quadrants, write down the dynamic equations in which you replace the sigmoid function by its value in that quadrant (0 or 1). Compute the fixed point by setting both equations to zero and solving for u and v.

2. Based on that fixed point (which is an attractor) for every quadrant, get an idea of what the vector field looks like. If the fixed point lies outside the quadrant, then the vector-field "points" toward the fixed point, which drives all initial values in that quadrant in the direction of the quadrant in which the fixed point lies. Make an approximate drawing of the vector field.

3. Bonus: If you have access to Matlab (available for free at RUB at

   `http://www.it-services.ruhr-uni-bochum.de/software/matlab`)

   download two files from the course web page:

   `singleNeuronInteractiveSim.m` and `sigmoid.m`

   and run the former. Control with the sliders the resting levels and inputs of the two neurons to build the equations (6) and (7). One neuron plays the role of the exitatory, the other of the inhibitroy neuron. Try to make the two neurons oscillate. You can use the information in the appendix of the paper to find the right parameter values.

4. Alternative variant: Download the Matlab package Cosivina here:

   `http://www.dynamicfieldtheory.org/cosivina`

   and find the code

   `launcherTwoNeuronSimulator.m`

   under examples. Run this program in Matlab and do the same as in the previous item.