



The Lorry I. Lokey Interdisciplinary Center
for Life Sciences and Engineering

NETWORK BIOLOGY RESEARCH LABORATORIES

Theoretical Neuroscience lab

Using math & physics to answer biological questions

Recurrent Neural Network as a Frequency Divider

Background

Frequency locking of a Recurrent Neural Network (RNN) at the stimulus frequency is a known and well explored phenomenon [3]. **Period doubling** and equivalently frequency division is considered an intermediate step between periodic and chaotic dynamics [2]. Manmade dividers are widely used in electronic industry, however, little known about **locking a Neural Network in divider regime**. This is exactly what we will try to do!

Project Goals & Estimated Timeline

We want to train a recurrent neural network to divide the stimulus frequency.

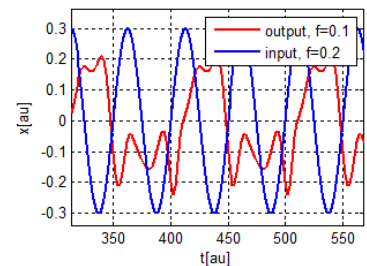
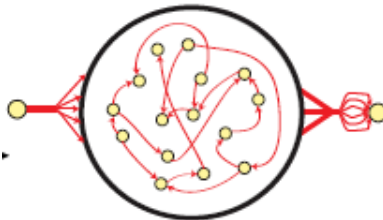
Here is how it could work:

- Get familiar with the RNN model we use [1]. (2 weeks)
- Train an RNN to work as a frequency divider. (6 weeks)
- Explore the neural dynamics of the trained network (as in [4]). (6 weeks)

If the results prove interesting the project can be extended for a full year.

Prerequisites

- Signals and Systems
- Linear Circuits
- Basic programming skills



Literature

[1] H. Jaeger (2001): Short term memory in echo state networks.

[2] http://www.scholarpedia.org/article/Period_doubling

[3] K. Rajan et al. (2010): Stimulus-dependent suppression of chaos in recurrent neural networks
Physical Review E 82, 011903

[4] Sussillo D, Barak O. (2013): Opening the Black Box: Low-dimensional dynamics in high-dimensional recurrent neural networks. Neural Computation. 25(3):626-649

Alexander Rivkind

Theoretical Neuroscience Lab

sashkarivkind@gmail.com



<http://barak.net.technion.ac.il>