A Bio-Inspired Spiking Model for Object Tracking in FMCW-Radar Data

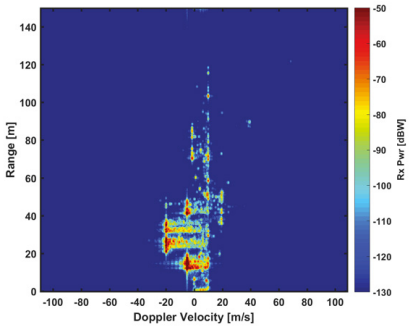

figure 1: FMCW Range-Doppler map. [1]

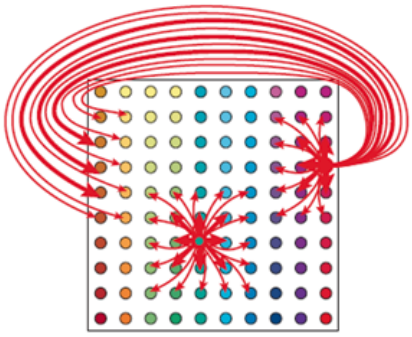

figure 2: Connections in an attractor network. [2]

Background

Although lidar sensors and vision systems are still the predominantly used sensors for automotive use cases, radar sensors receive more and more attention, mainly due to their robustness with regards to the weather. In contrast to lidars and cameras, radar sensors are able to detect objects even in problematic weather conditions like snowfall or fog.

The detection and tracking of objects in automotive use cases is commonly done with either filter based algorithms [3] or artificial neural networks (ANNs) [4]. Both approaches, however, require extensive computational resources and with that electrical power.

Spiking neural networks (SNNs) are the third generation of neural networks [5]. Unlike ANNs, these networks process data asynchronously and sparsely, namely through so called spikes. This is inspired by the mammalian brain, where neurons are connected with numerous synapses and communicate through spikes. This potentially leads to highly efficient networks with a reduced energy consumption compared to ANNs by a power of ten [6].

Task Description

The objective of this thesis is to develop an object detection and tracking algorithm using SNNs on radar data based on biologically inspired (continuous) attractor networks [7]. This network type is a commonly used model for describing cells in the mammalian hippocampus. One task the network is used to model is path integration, which is basically an egocentric tracking [8].

Your task will it be to implement a spiking continuous attractor network including neuron models, synapses, etc. and either train it or set the weights manually to perform object (person/car) tracking on radar data.

During this project you will be

- doing an extensive literature research to find suitable approaches
- designing and developing your own spiking neural network
- implementing the network in either Python or C++ (from scratch or using a library)
- testing the system (on neuromorphic hardware) and documenting your work

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References

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