UNIVERSITY
OF OSLO

MES
Mikro Elektroniske Systemer

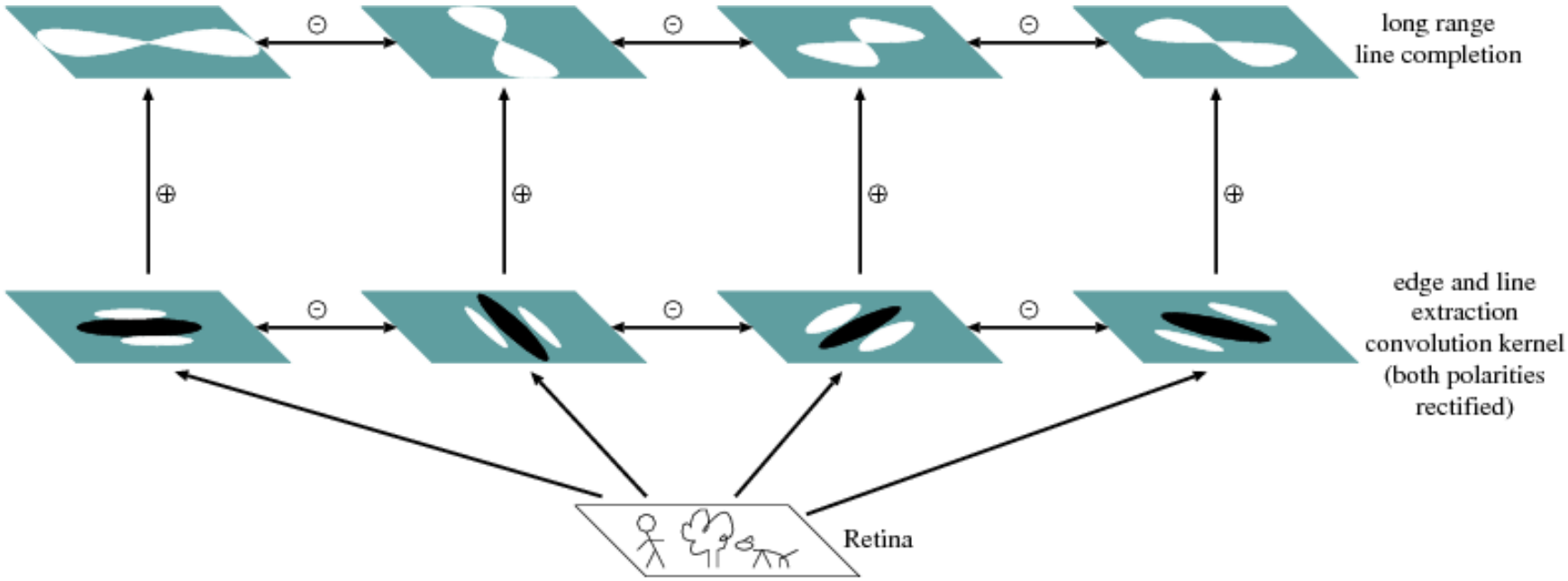
Neuromorphic Electronics

An Example of a Neuromorphic System

The CAVIAR demonstrator: the biggest AER system ever assembled

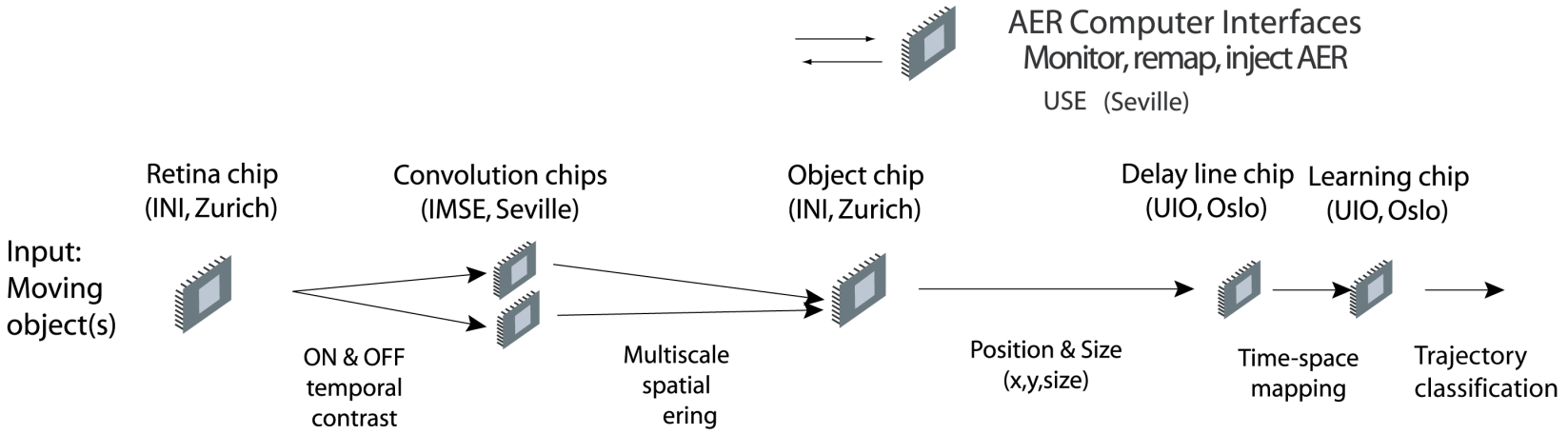
Philipp Häfliger *hafliger@ifi.uio.no*

Inspiration: BCS (boundary contour system)

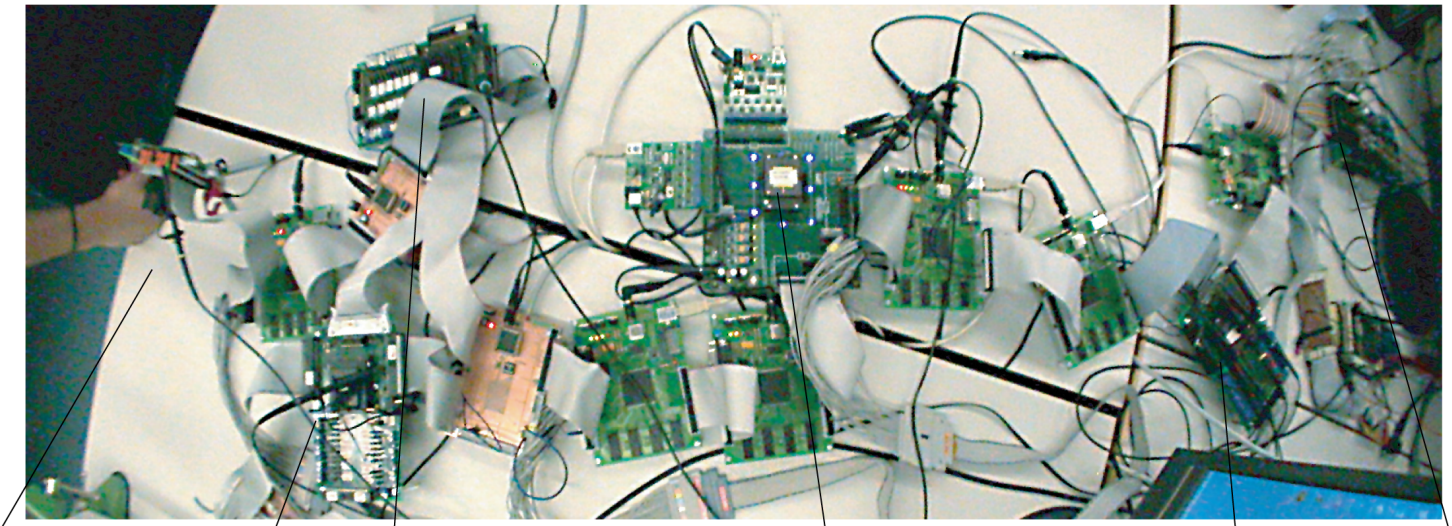


System Overview

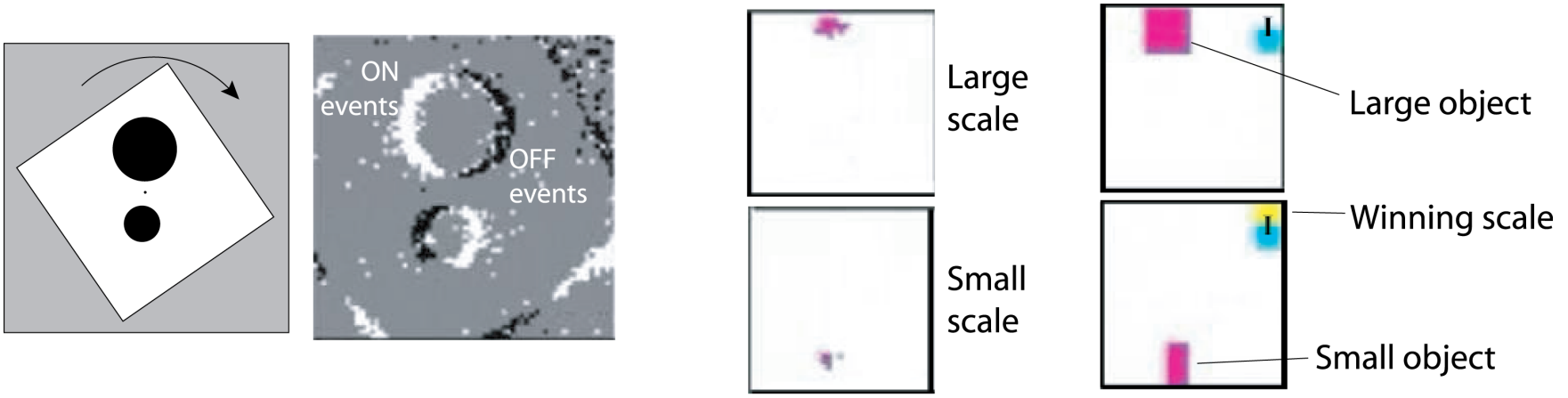
CAVIAR components use the Address-Event Representation (AER) for communication. The identities of spiking neurons are communicated asynchronously on shared digital buses.



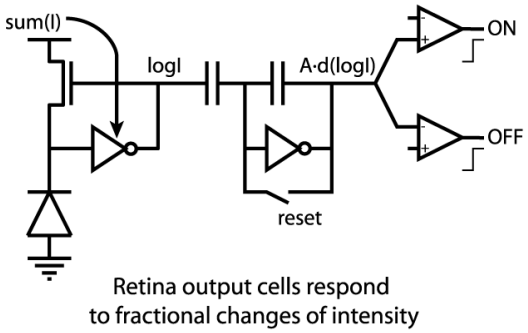
Physical System



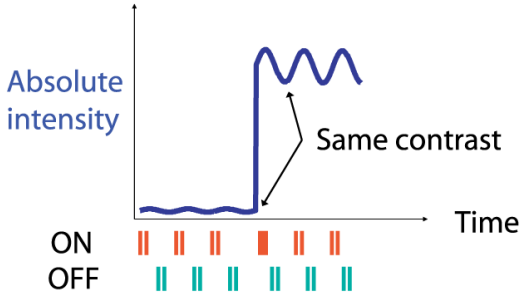
Retina, Convolution, and Object WTA Function

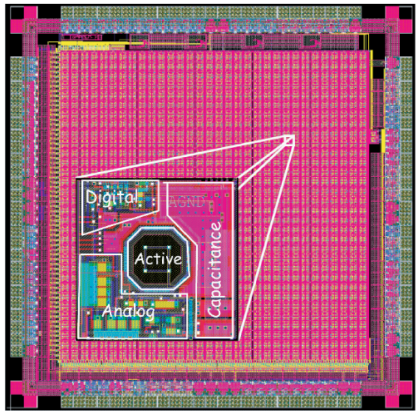


Diff Log Retina



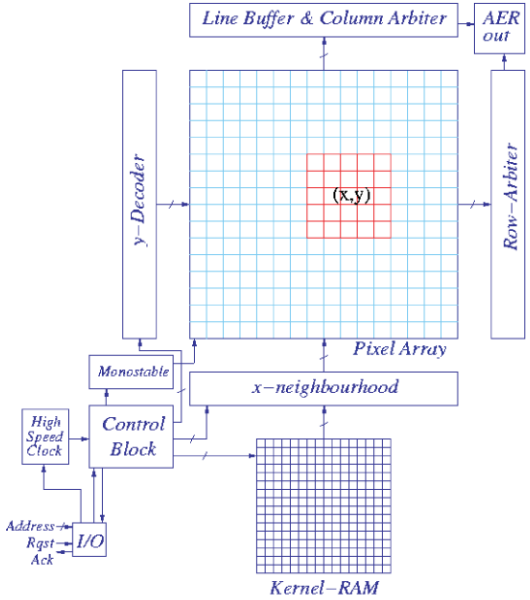
Retina output cells respond
to fractional changes of intensity

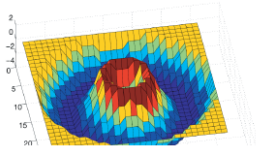




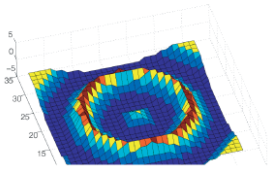
64x64
Pixel size $(40u)^2$, Fill factor 9%, Dark level, 1lux
1 Meps
2 mA chip, 20mA board

Convolution Chip

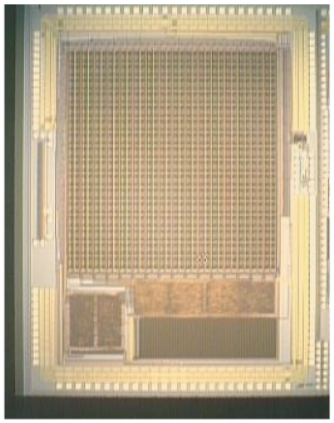




`small' kernal

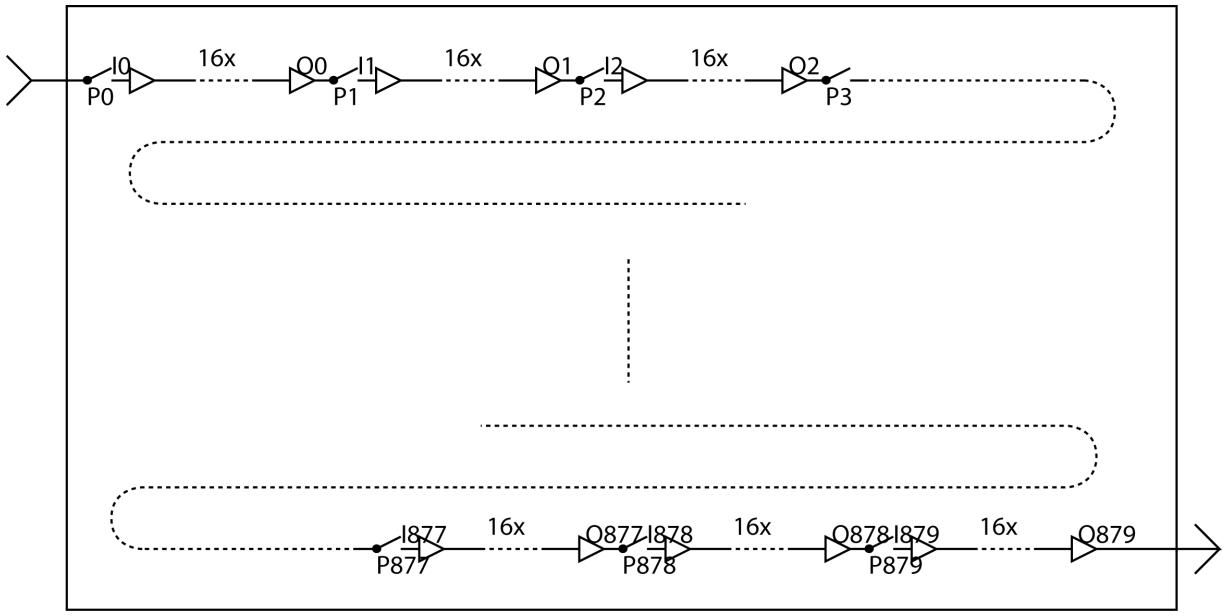


`large' kernal

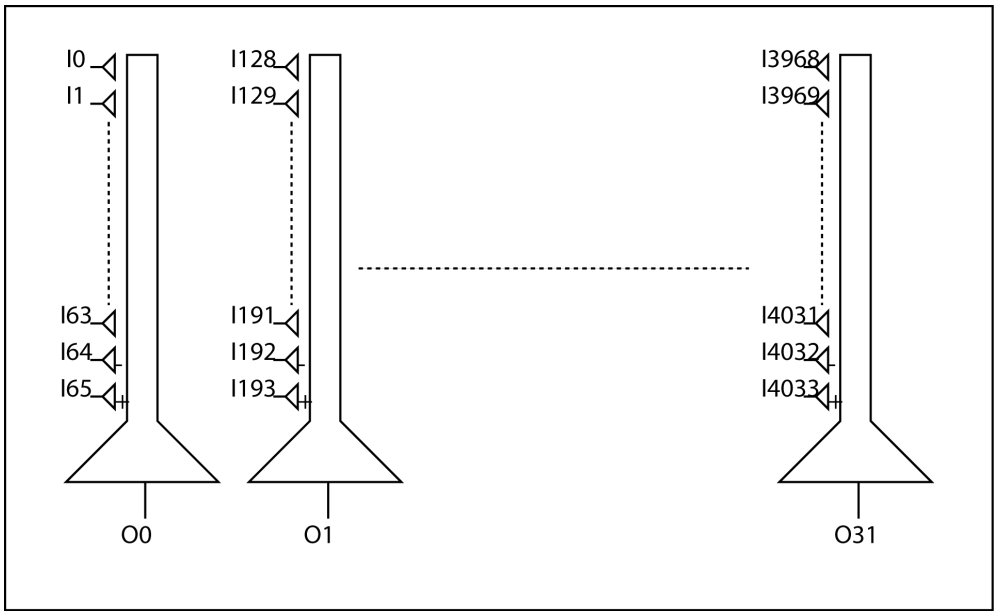


32x32
arbitrary kernal size with 3 bit weights
input 3-33 Meps, output 25Meps
"convolution throughput" 1-10^7
20-45mA chip, +20mA board

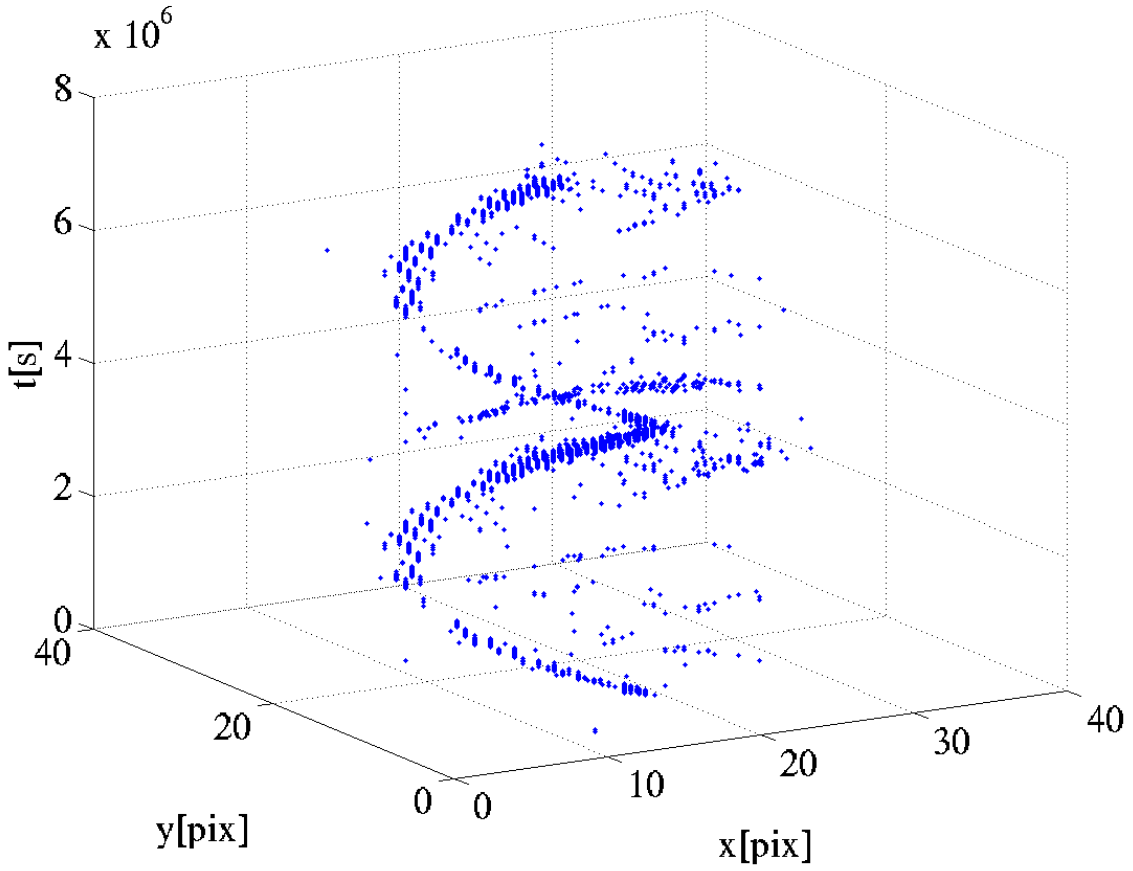
Spatio Temporal Classification (1/2)



Spatio Temporal Classification (2/2)

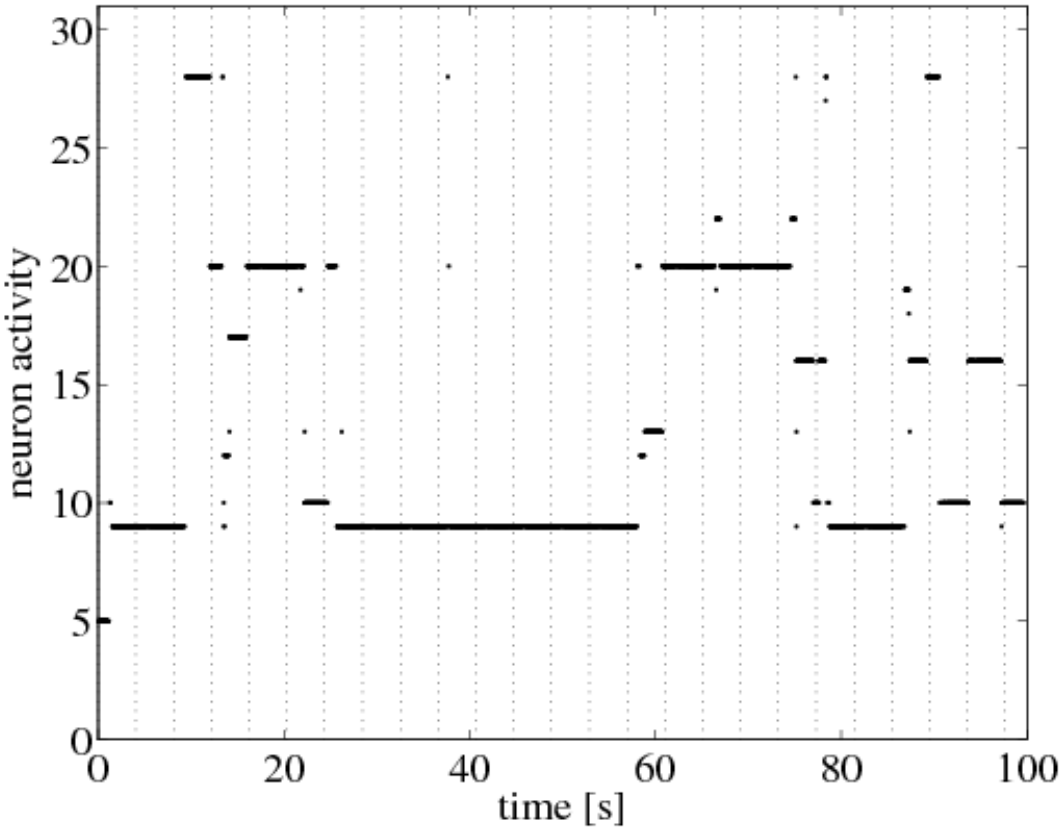


Expanding Time into Space



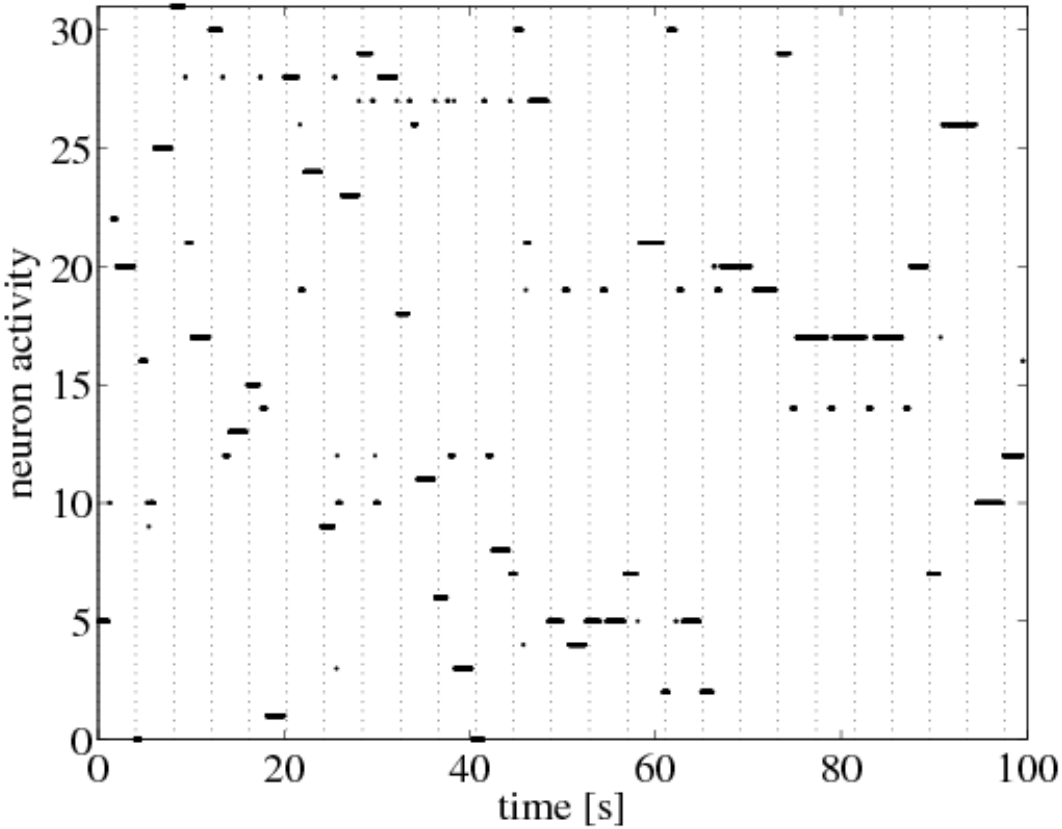
Classification of Phases in a Cyclic Motion Pattern (1/3)

Random Weights



Classification of Phases in a Cyclic Motion Pattern (2/3)

During Learning



Classification of Phases in a Cyclic Motion Pattern (3/3)

After Learning