NeuComp Project

Academy RISE – IDEX UCA^JEDI

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Université Côte d'Azur / CNRS UMR 7248

NeuComp Project

- Project:
  - Modeling, verification, simulation and hardware implementation of artificial neural networks
  - First phase: Jan. 2017 – Sept. 2017
- Partners:
  - LEAT: B. Miramond, D. Gaffé,   L. Khacef, U. Alakbarova
  - I3S: A. Muzy, E. Demaria,   J. Goutey, T. Lyvonnet
  - INRIA: A. Resouche,   F. Bouhlel, C. Girard
  - LJAD: F. Grammont
- Fundings:
  - Academy RISE: 19k€   = Internships, BioComp Summer School, Hardware prototyping platform (FPGA)
 - C@UCA: 7k€   = Spinnaker platform
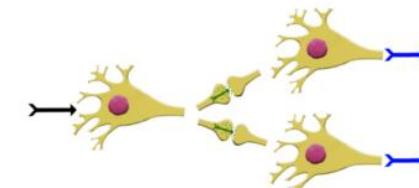
From discrete models of spiking neurons to efficient hardware implementation


Modeling of spiking neurons
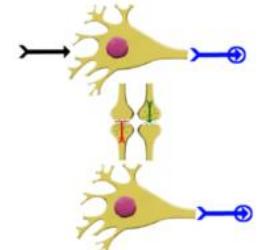
- Timing & Discrete modeling
- Archetypes and composition of neurons
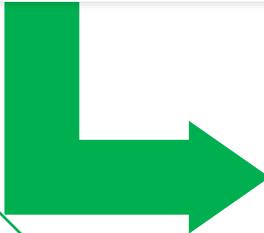
Simple series   Parallel composition   Retroaction loop
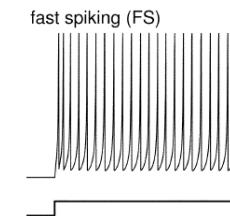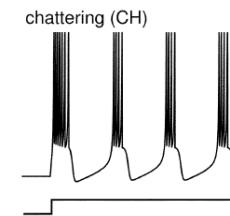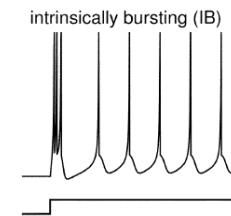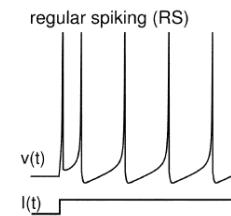
[DeMaria_2016]

Verification of timing properties

- LUSTRE synchronous language
- Model checkers

regular spiking (RS)   intrinsically bursting (IB)   chattering (CH)   fast spiking (FS)

v(t)

I(t)

[Izhikevich_2003]

NeuComp

Hardware implementation
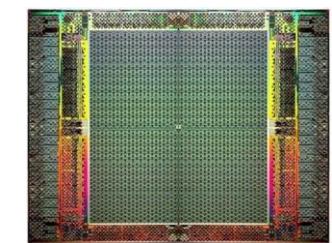
- Neuromorphic architectures
- Energy efficiency

ARM-based Spinnaker platform (HBP Project)

[Furber_2015]
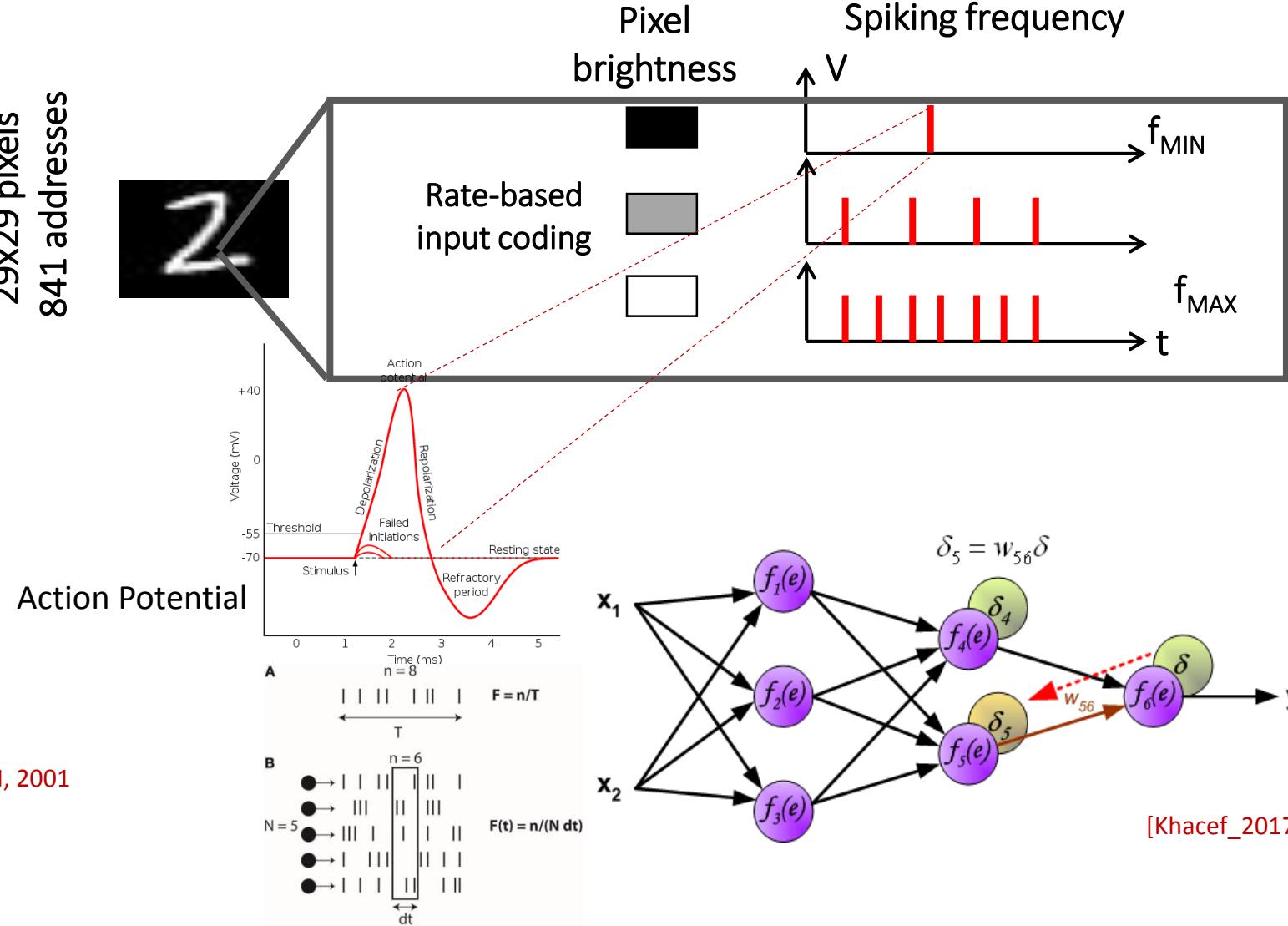
FPGA-based Neuromoprhic architecture (LEAT)

[Miramond_2015]

Application example
& impact of the impulsional coding

- Information coding
  - **Rate coding**
  - Time coding
  - Rank order coding
  - Population coding
  - Predictive spike coding
  - ...

29x29 pixels
841 addresses

Pixel brightness

Rate-based input coding

Spiking frequency

f_{MIN}

f_{MAX}

Action Potential

[Thorpe01] Spike-based strategies for rapid processing, S. Thorpe et al, NN, 2001

[Brette15] Philosophy of the Spike: Rate-Based vs. Spike-Based Theories of the Brain, R. Brette, fontiers in Systems Neuroscience, 2015

$\delta_5 = w_{56}\delta$

$[Khacef\_2017]$

See you on the NeuComp stand

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