Bachelor Project Mid-Term Presentation

Representation of auditory signals by neuronal spike trains

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LCN Lab Meeting 12 April 2013

Plan

- Presentation in three parts :
  - Introduction
  - Results
  - Summary & Outlook

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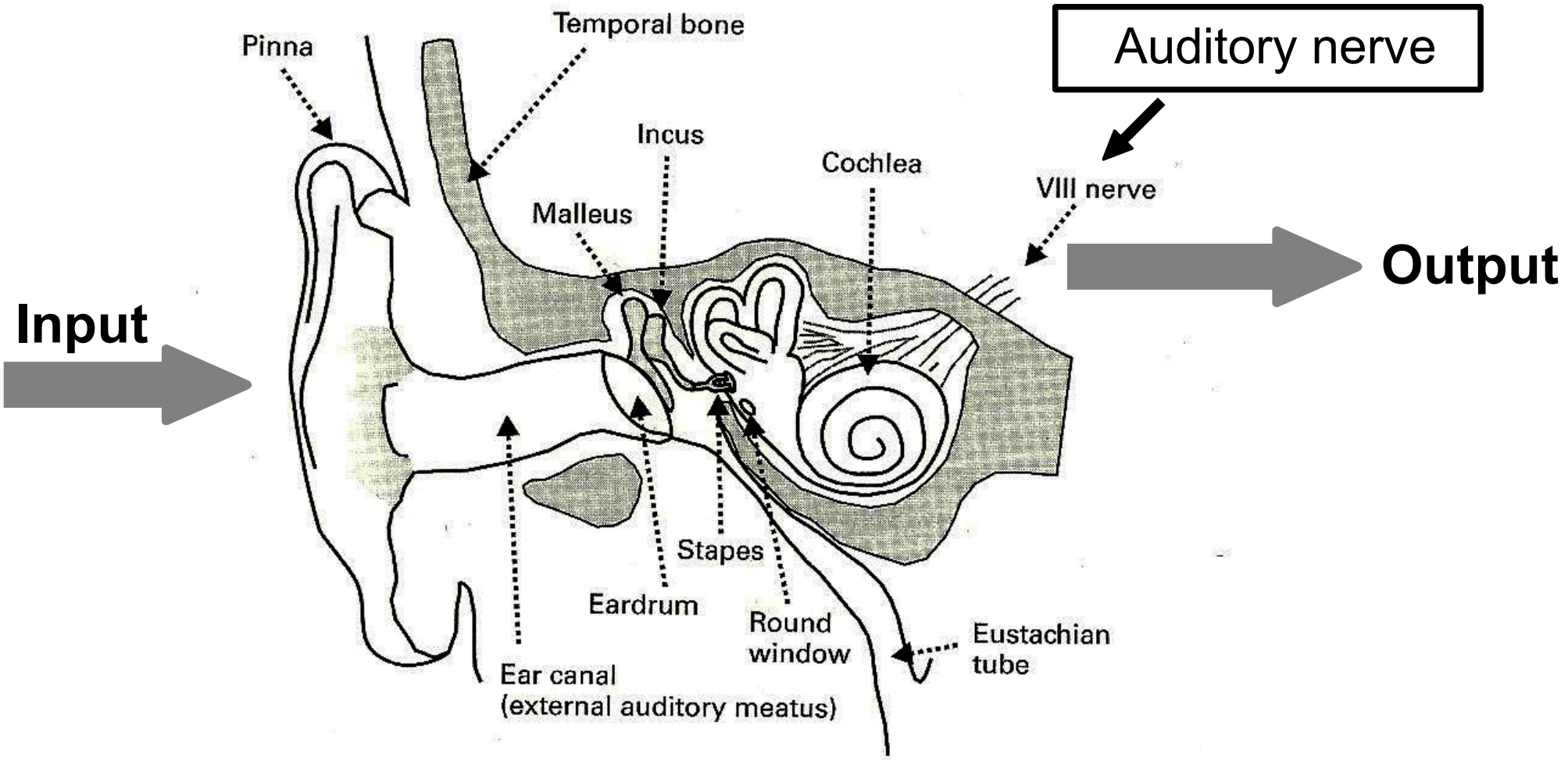
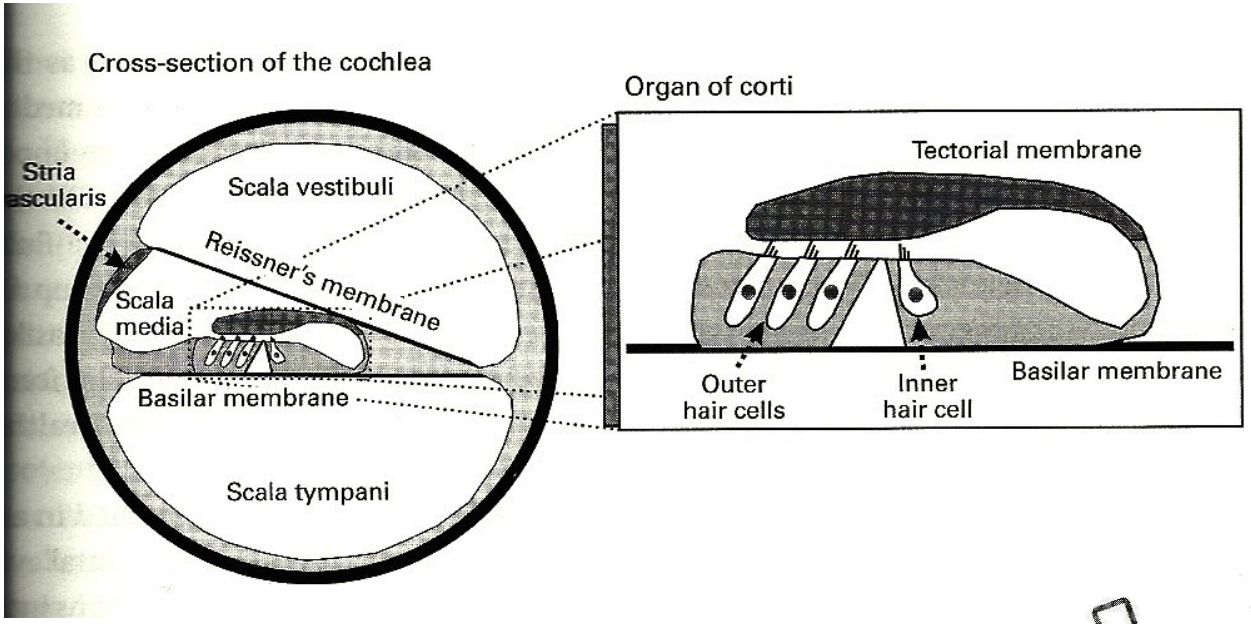
Auditory System



- Input : air pressure signal
- Output : spikes

Image source : «Auditory Neuroscience », Schnupp et al., 2011, MIT Press p52

Auditory System



Cross-section of cochlea

Hair cell transduction mechanism :

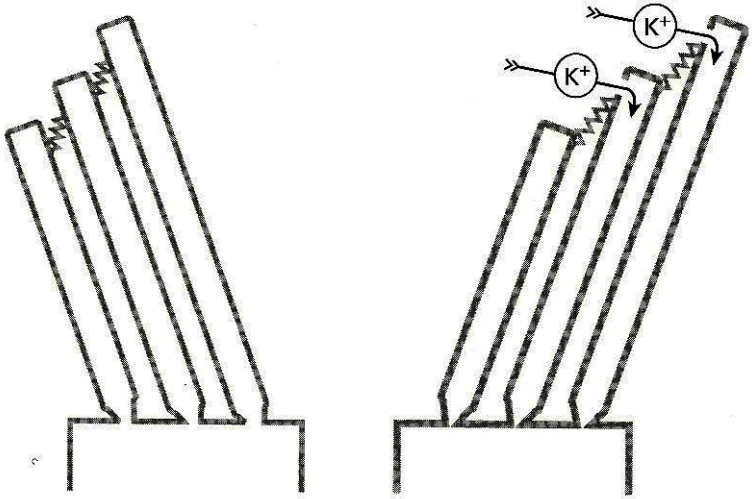


Image source : «Auditory Neuroscience », Schnupp et al., 2011, MIT Press p 65, 66

Goal of project

- Study the influence of absolute refractory period on signal encoding

Approach

- Use computational model for cat auditory-nerve responses from Zilany et al. (JASA, 2009)

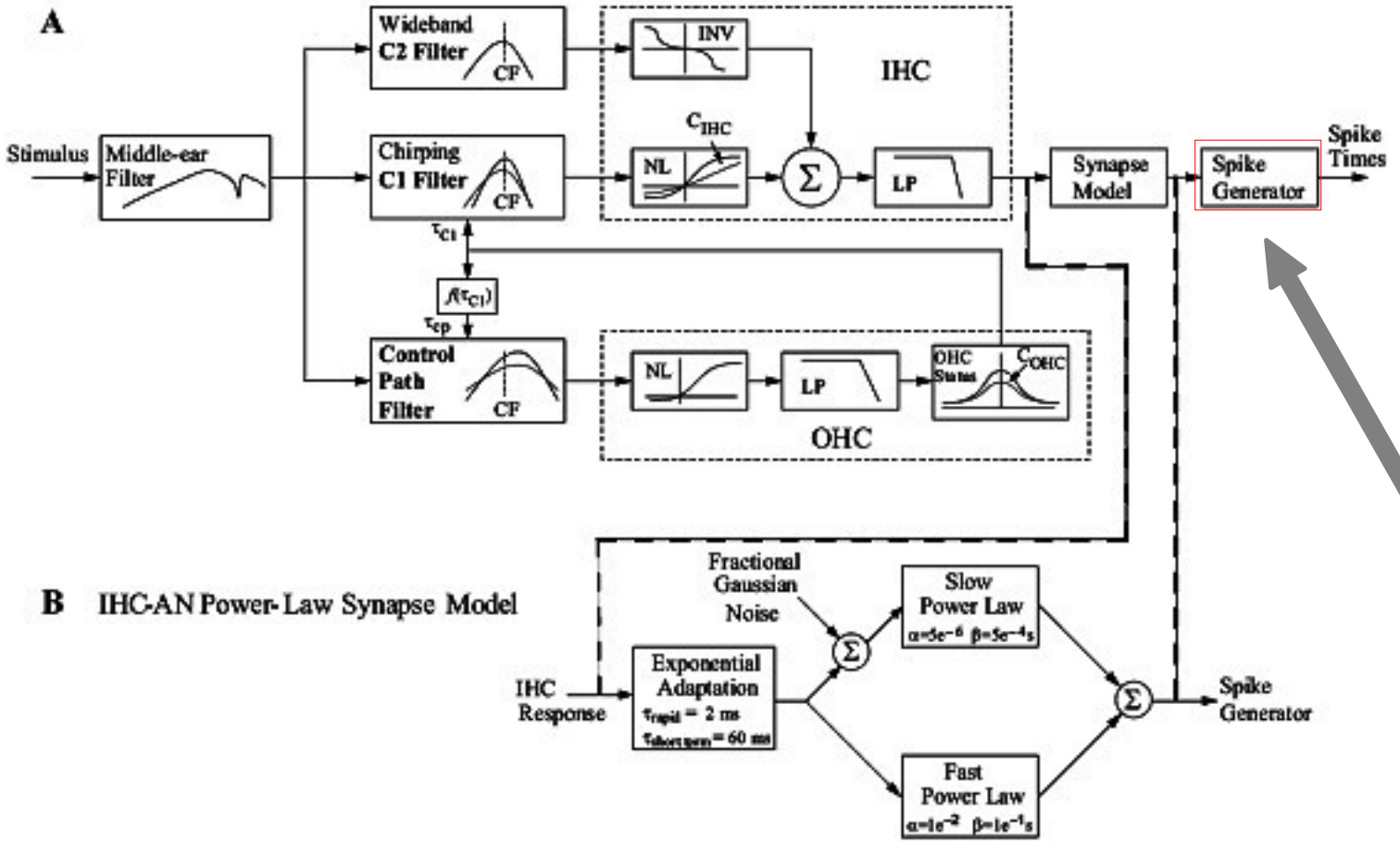
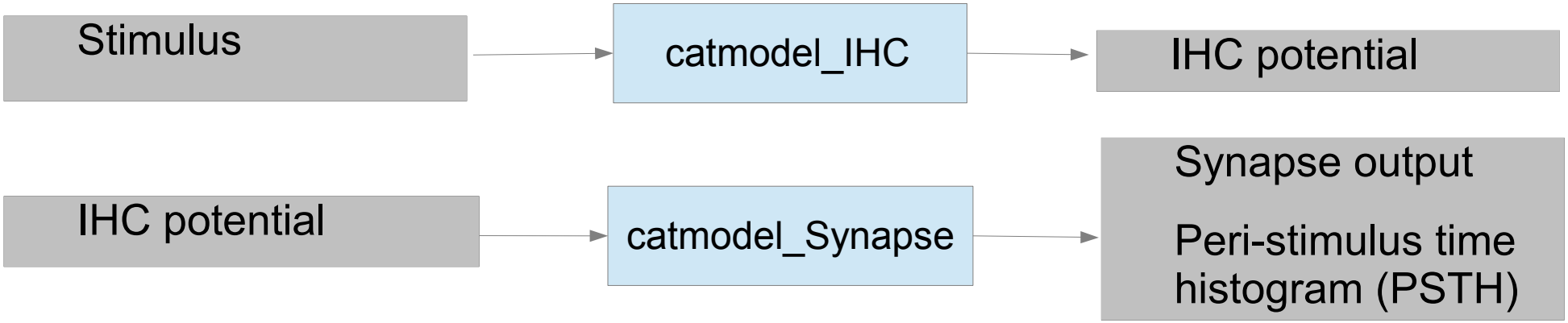


Image source : http://www.bme.rochester.edu/people/faculty/bio/project.php?id=229&projectId=203 , 04.04.2013

- Modify value of the absolute refractory period

Model use

- Main shema:



We must also specify to the model :

sampling rate

time before repetition and number of repetitions of experiments

characteristic frequency (CF) of the IHC and fiber we want to test

type of fiber : low, medium or high spontaneus rate (SR)

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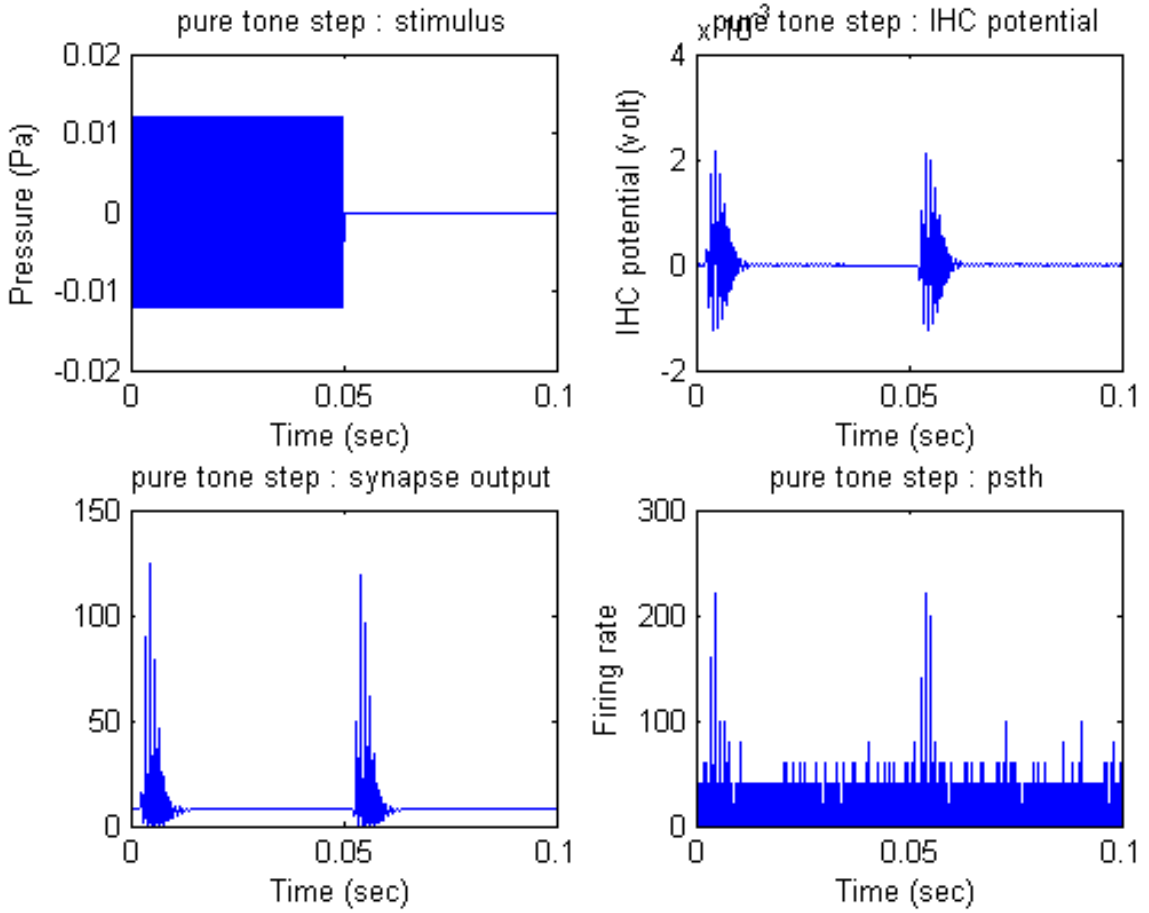
Experiments

- 4 types of experiments (stimuli):
  - Pure tone
  - Click
  - Modulated Noise
  - Modulated pure tone

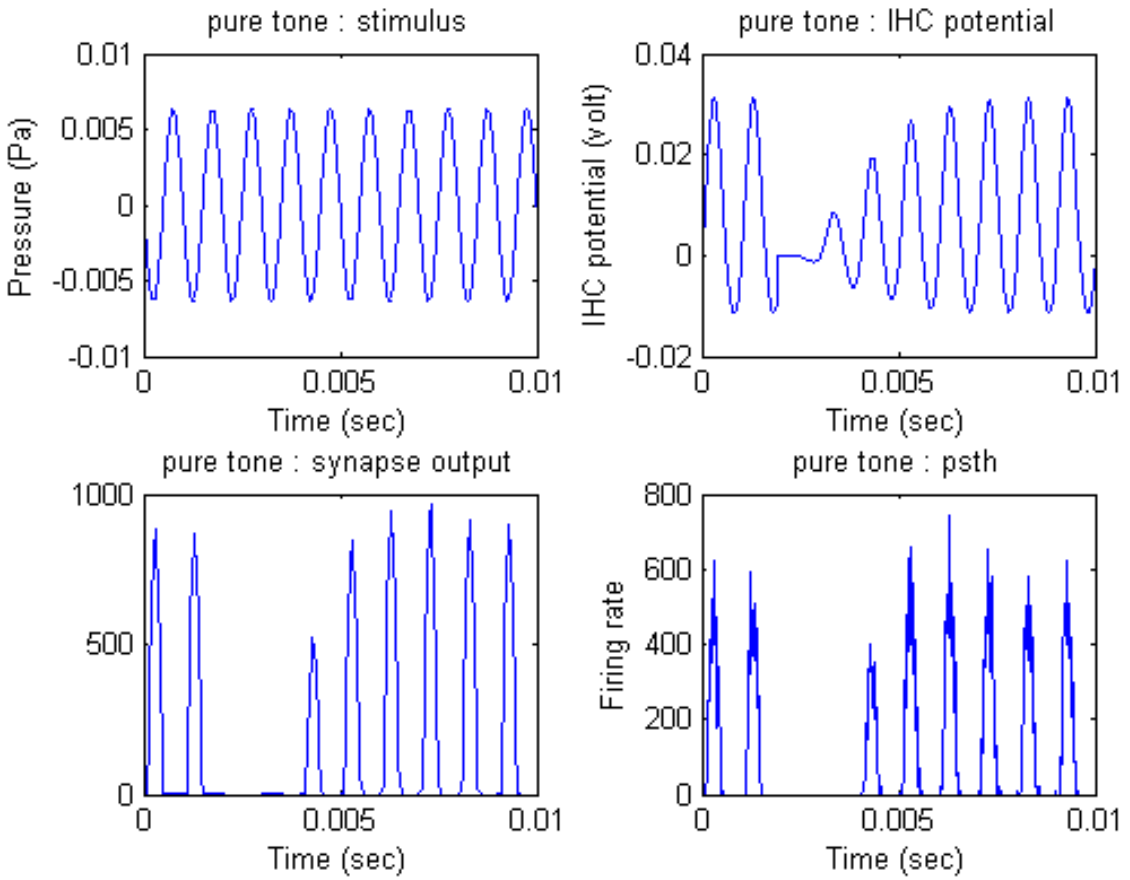
- Each of them with or without absolute refractory period

Modulated pure tone experiment



- Stimulus : pure tone 10kHz modulated with f = 10Hz, amplitude 6.32e-3 Pa
- Period time : 100ms
- Fibertype : medium SR
- Sampling rate : 10e-5 s
- 5'000 repetitions
- CF : 1kHz
- With absolute refractory period

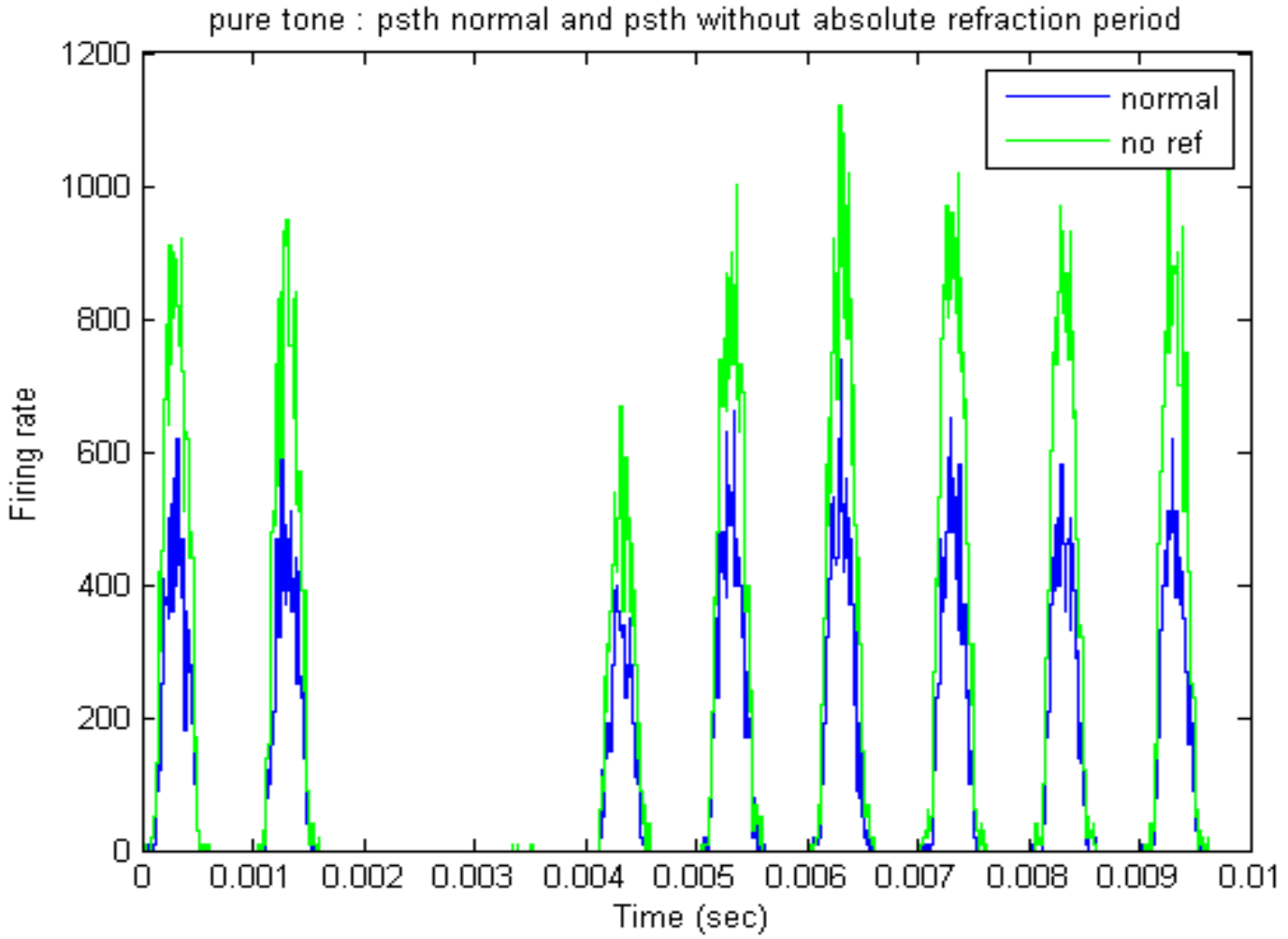
Pure tone experiment



- Stimulus : pure tone 1kHz, amplitude 6.32e-3 Pa
- Period time : 10ms
- Fibertype : medium SR
- Sampling rate : 10e-5 s
- 10'000 repetitions
- CF : 1kHz
- With absolute refractory period

Refractory period comparison

- Example for the pure tone :

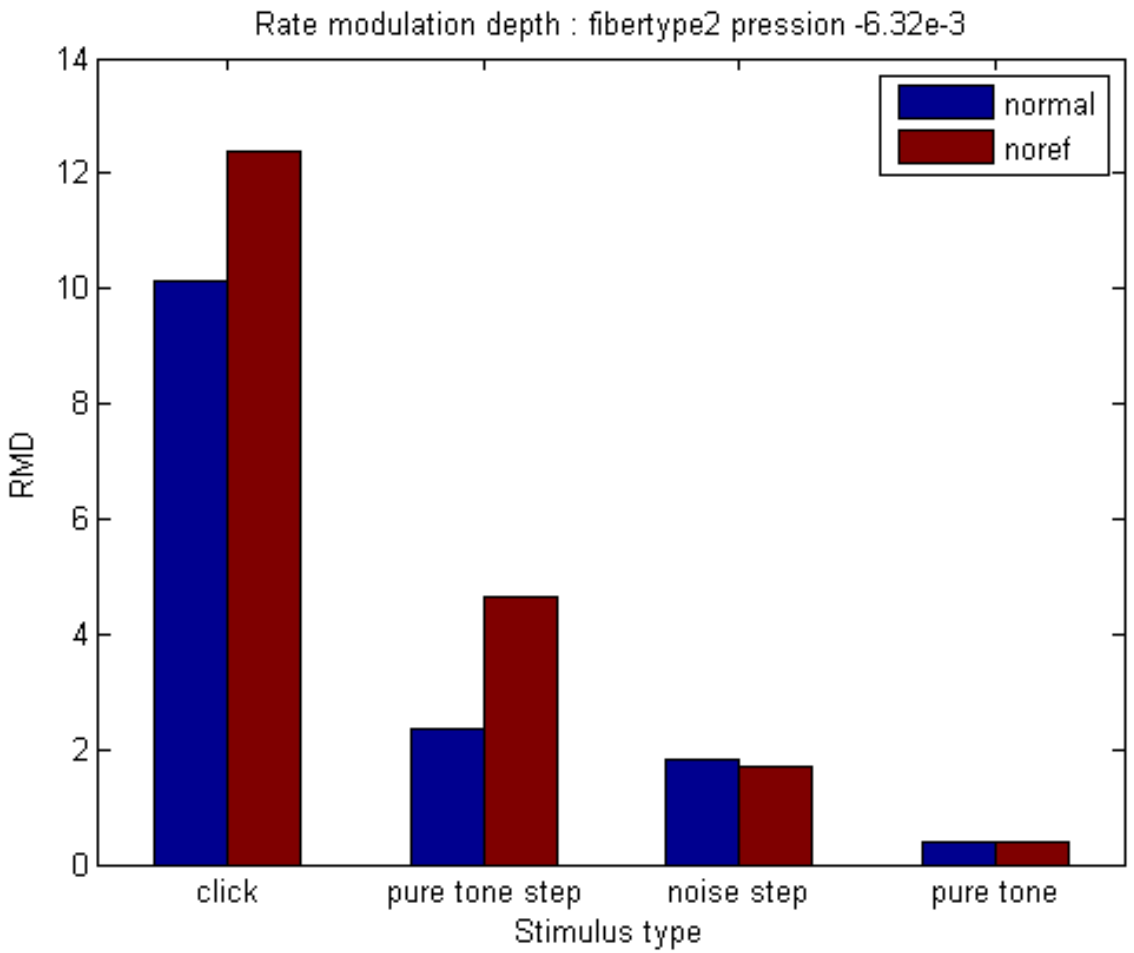


Rate modulation depth (RMD)

- Tool to compare experiments with and without absolute refractory period
- On the form (x-y)/y, x = max(psth) for all experiments ; y is the baseline
- Click : y = psth just before next click
- Pure tone : y = mean(psth)
- Modulated pure tone and modulated noise : y = psth just before the end of the step

Rate modulation depth result

- Stimulus amplitude : 6.32e-3 Pa
- Fiber type : medium SR
- Sampling rate : 10e-5 s
- CF : 1kHz



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Summary & Outlook

- Absolute refractory period influences output
- Without it, the RMD is bigger for some stimuli

- Now we have to go beyond RMD and look at the Fourier spectrum of the PSTH
- Results might depend on frequency
- See if the effects corresponds to what is predicted by Deger et al. (2010)