MODULATION OF OSCILLATORY ACTIVITY AND SYNCHRONY IN V1 AS A FUNCTION OF STIMULUS FEATURES
A. Dăbăcan1, H. Bărzan 1, M. Gheorghiu 1, R. C. Mureșan1
1Coneural, Romanian Institute of Science and Technology, Cluj Napoca, ROMANIA

Introduction
Neurons in visual cortex exhibit gamma-band activity (30-80 Hz) in response to visual stimulation [2]. However, the relationship between visual input and oscillatory response is not yet completely understood [4]. Here, we propose a systematic exploration of the stimulus-response relationship, from the perspective of oscillatory activity.

Methods
• Visual stimuli: oriented moving gratings: 8 orientations, 3 levels of contrast.
  - grating movement - modulating local luminance
  - global contrast modulation - modulating stimulus strength
  - 8 orientations - modulating preferred stimulation condition.
• Recorded data: We recorded extracellular neural activity in response to the stimulus palette using silicon probes:
  - Local Field Potentials (LFP).
  - Multi Unit Activity (MUA).
• Extracted features: to characterize response properties in the Gamma range:
  - LFP properties
    - power in gamma band.
    - frequency of gamma band activity.
  - MUA properties:
    - firing rate.
    - oscillation score in gamma band [3].

Luminance and Contrast effects on oscillation features
Local luminance modulation [1]
• Passage of bright bar through visual field causes gamma power increase, underlaid by an increasing firing rate of the recorded population.
• Gamma power and frequency are poorly correlated. Frequency is highest at entry of bright bar in the visual field and decreases as it passes by, whereas power is maximal when bar is in the center of the visual field.

Global contrast response statistics
Response features increase with contrast as a general population average. However, Gamma power and frequency dependency to contrast is highly variable across channels and orientations:

Contrast effects on orientation tuning
• Orientation tuning increases from 25 to 50% contrast, but further increase in contrast decreases response specificity. Orientation tuning becomes broader at 100% contrast.

Discussion
• On average, power and frequency appear to correlate when stimulus input strength is modulated.
• Local luminance fluctuation differentially modulates gamma power and frequency.
• For individual channels and orientations, the relationship between contrast and gamma features is highly variable and its statistics depend on contrast levels.
• Contrast has nonlinear effects on complex response features, such as orientation tuning.
Gamma response features do not obey existing models of gamma generation, hence the need for an alternative model.


This work was supported by CNCS - UEFISCUD projects PNII-IDEI-2014-4-006/2015 contract no 169/2015 and PN-III-P4-ID-PCE-2016-0030, contract no 78/12.07.2017.