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AUGUST 14-18, 2023
SEOUL OLYMPIC PARKTEL
SEOUL, KOREA

HOSTED BY

KPS The Korean Physical Society

ORGANIZED BY

KPS Division of Biological Physics, the Korean Physical Society

KIAS KOREA INSTITUTE FOR ADVANCED STUDY

CO-ORGANIZED BY

BRL Leukemia control laboratory based on genomic instability research

Cell Nuclear Biophysics Basic Research Laboratory

KSCC KAIST Stem Cell Center

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IUPAP International Union of Pure and Applied Physics

apctp asia pacific center for theoretical physics

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CDLC Center for Chemical Dynamics in Living Cells, National Research Foundation of Korea

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KOFST Korean Federation of Science & Technology Societies

SEOUL METROPOLITAN GOVERNMENT

POSTER PRESENTATION

Symposium X. Biological Network

09:00-12:15, THURSDAY, August 17 **Olympia (1F)**

Chair Jejoong Yoo (Sungkyunkwan University, Korea)

10-0257 Effect of Adult-Born Immature Granule Cells on Pattern Separation in the Hippocampal Dentate Gyrus
Sang-Yoon Kim, Woochang Lim
Daegu National University of Education, Korea

10-0360 A RBN toward a Critical Point
Tomoko Sakiyama
Soka University, Japan

10-1239 Spiking Dynamics and Network Morphology in a Reward Pavlovian Learning Spiking Neural Network
In Hoi Jeong, Kyoung Jin Lee
Korea University, Korea

10-1408 A Revised Model for Cerebellar Motor Learning: Uncovering the Brain Network through Connectomics
Changjoo Park[1], Jawon Gim[2], Sangkyu Bahn[2], Gyu Hyun Kim[2], Yoonseok Im[1], Sang-Hoon Lee[2], Kisuk Lee[3], Jungeun Son[2], Kea Joo Lee[2], Jinseop Kim[1]
[1]Sungkyunkwan University, Korea, [2]Korea Brain Research Institute, Korea, [3]Massachusetts Institute of Technology, USA

10-1524 Identification of the Gustatory Receptor Neurons and Mapping the Gustation Circuits of Drosophila
Seongbong Yu, Chaiyoung Jeong, Chanhyuk Kang, Jinmook Lee, Han Hee Jeong, Hyeanki Shim, Keehyun Kate Park, Hye Sun Jang, Minkook Choi, Jinseop Kim, Jae Young Kwon
Sungkyunkwan University, Korea

10-1545 Generalized Michaelis–Menten Rate Law with Time-varying Molecular Concentrations
Junghun Chae[1], Cheol-Min Ghim[1], Pan-Jun Kim[2], Roktaek Lim[2], Thomas Martin[2], WooJoong Kim[1]
[1]Ulsan National Institute of Science and Technology, Korea, [2]Hong Kong Baptist University, Hongkong

10-1565 Wiring Specificity in the Cerebellar Molecular Layer Discovered by Computational Analysis of the Ultrastructure
Yoonseok Im[1], Changjoo Park[1], Sangkyu Bahn[2], Seongbong Yu[1], Junsoo Park[1], Jinseop Kim[1]
[1]Sungkyunkwan University, Korea, [2]Korea Brain Research Institute, Korea

10-1595 Chaos in Glycolytic Oscillations
Pureun Kim, Changbong Hyeon
Korea Institute for Advanced Study, Korea

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Effect of Adult-Born Immature Granule Cells on Pattern Separation in The Hippocampal Dentate Gyrus

Sang-Yoon Kim, Woochang Lim*

Daegu National University of Education, Korea

Young immature granule cells (imGCs) appear via adult neurogenesis in the hippocampal dentate gyrus (DG). In comparison to mature GCs (mGCs) (born during development), the imGCs exhibit two competing distinct properties such as high excitability and low excitatory innervation. We develop a spiking neural network for the DG, incorporating the imGCs, and investigate their effect on pattern separation (i.e., a process of transforming similar input patterns into less similar output patterns). We first consider the effect of high excitability. The imGCs become very highly active due to their low firing threshold. Then, because of high activation, strong pattern correlation occurs, which results in pattern integration (i.e., making association between events). On the other hand, the mGCs exhibit very sparse firing activity due to strongly increased feedback inhibition (caused by the high activation of the imGCs). As a result of high sparsity, the pattern separation efficacy (PSE) of the mGCs becomes very high. Thus, the whole population of GCs becomes a heterogeneous one, composed of a (major) subpopulation of mGCs (i.e., pattern separators) with very low activation degree $D_a^{(m)}$ and a (minor) subpopulation of imGCs (i.e., pattern integrators) with very high activation degree $D_a^{(im)}$. In the whole heterogeneous population, the overall activation degree $D_a^{(w)}$ of all the GCs is a little reduced in comparison to the activation degree $D_a^{(out)}$ in the presence of only mGCs without imGCs. However, no pattern separation occurs, due to heterogeneous sparsity, in contrast to the usual intuitive thought that sparsity could improve PSE. Next, we consider the effect of low excitatory innervation for the imGCs, counteracting the effect of their high excitability. With decreasing the connection probability of excitatory inputs to the imGCs, $D_a^{(im)}$ decreases so rapidly, and their effect becomes weaker. Then, the feedback inhibition to the mGCs is also decreased, leading to increase in $D_a^{(m)}$ of the mGCs. Accordingly, $D_a^{(w)}$ of the whole GCs also increases. In this case of low excitatory connectivity, the imGCs perform pattern integration. On the other hand, due to increase in $D_a^{(m)}$, the PSE of the mGCs decreases from a high value to a limit value. In the whole population of all the GCs, when the excitatory connection probability decreases through a threshold, pattern separation starts, the overall PSE increases and approaches that of the mGCs. However, due to heterogeneity caused by the imGCs, the overall PSE becomes deteriorated, in comparison with that in the presence of only mGCs.