Title

CREATING NOVEL GOAL-DIRECTED ACTIONS AT CRITICALITY: A NEURO-ROBOTIC EXPERIMENT

Journal

New Mathematics and Natural Computation, 05(01)

ISSN

1793-0057 1793-7027

Authors

ARIE, HIROAKI
ENDO, TETSURO
ARAKAKI, TAKAFUMI
et al.

Publication Date

2009-03-01

DOI

10.1142/S1793005709001283

CREATING NOVEL GOAL-DIRECTED ACTIONS AT CRITICALITY: A NEURO-ROBOTIC EXPERIMENT

HIROAKI ARIE, *TETSURO ENDO*, *TAKAFUMI ARAKAKI*, *SHIGEKI SUGANO*, *JUN TANI*

DOI: 10.1142/S1793005709001283

HIROAKI ARIE et al, *New Math. and Nat. Computation* **05**, 307 (2009). DOI: 10.1142/S1793005709001283

CREATING NOVEL GOAL-DIRECTED ACTIONS AT CRITICALITY: A NEURO-ROBOTIC EXPERIMENT

HIROAKI ARIE
RIKEN Brain Science Institute, 2-1 Hirosawa, Wako-shi, Saitama 351-0198, Japan

TETSURO ENDO
Department of Advanced Mechanical Engineering, Waseda University, 3-4-1 Okubo, Shinjuku-ku, Tokyo 169-8555, Japan

TAKAFUMI ARAKAKI
Department of Advanced Mechanical Engineering, Waseda University, 3-4-1 Okubo, Shinjuku-ku, Tokyo 169-8555, Japan

SHIGEKI SUGANO
Department of Advanced Mechanical Engineering, Waseda University, 3-4-1 Okubo, Shinjuku-ku, Tokyo 169-8555, Japan

JUN TANI
RIKEN Brain Science Institute, 2-1 Hirosawa, Wako-shi, Saitama 351-0198, Japan

The present study examines the possible roles of cortical chaos in generating novel actions for achieving specified goals. The proposed neural network model consists of a sensory-forward model responsible for parietal lobe functions, a chaotic network model for premotor functions and prefrontal cortex model responsible for manipulating the initial state of the chaotic network. Experiments using humanoid robot were performed with the model and showed that the action plans for satisfying specific novel goals can be generated by diversely modulating and combining prior-learned behavioral patterns at critical dynamical states. Although this criticality resulted in fragile goal achievements in the physical environment of the robot, the reinforcement of the successful trials was able to provide a substantial gain with respect to the robustness. The discussion leads to the hypothesis that the consolidation of numerous sensory-motor experiences into the memory, meditating diverse imagery in the memory by cortical chaos, and repeated enaction and reinforcement of newly generated effective trials are indispensable for realizing an open-ended development of cognitive behaviors.

Keywords: Novel goal-directed action; chaotic dynamics; criticality; CTRNN