## Generative adversarial brain: a comprehensive study of multi-agent learning by natural and artificial intelligence

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## Purpose and Background of the Research

### ● Outline of the Research

Although the recent progress in AI research has realized super-human image, audio, or language processing, it is still far from generalized AI. Since it would be difficult to prepare big-data in the scenario of motor control or decision making, a technique to allow already-trained functional modules to be reused for another functions (transfer learning) is highly demanded. Keeping 'generative adversarial brain' as a working hypothesis, we will elucidate its implementations in the human and primate brain, develop a brain-based AI algorithm, and apply it to human-harmonic robotics.



Computational neuroscience

Generative adversarial brain
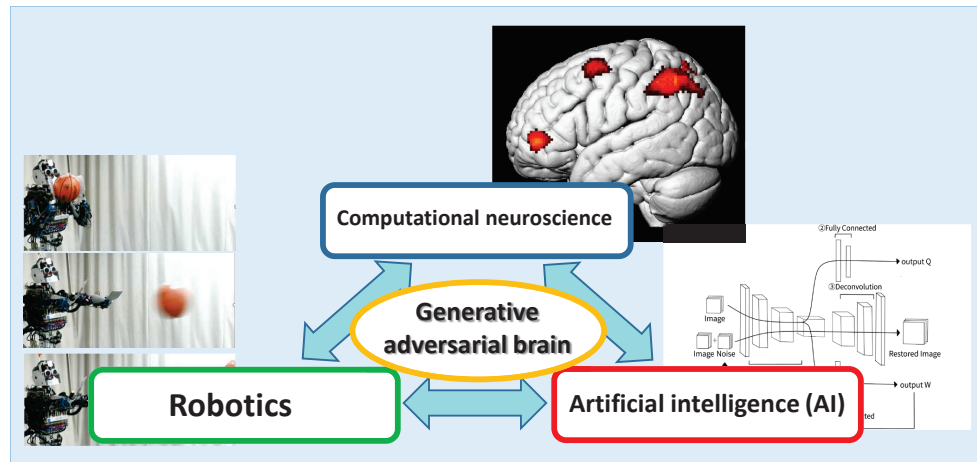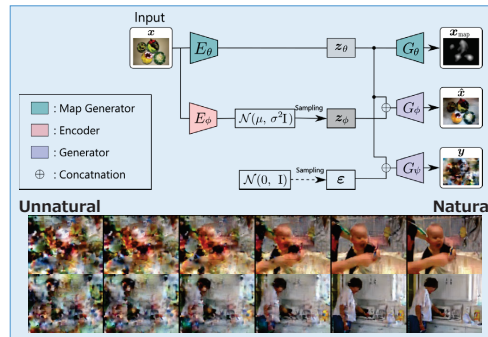
Robotics

Artificial intelligence (AI)

Figure 1. Outline of Research. An interdisciplinary research covering computational neuroscience, AI, and robotics, with the working hypothesis of 'generative adversarial brain' will be performed.

### ● Computational neuroscience of generative adversarial brain

We will examine mechanisms in basic modules of generative adversarial brain, generator and discriminator, within human and primate. We perform fMRI and electrophysiological experiments with the help of AI technology.



Figure 2. We examine human's discriminator using artificial images (lower panel) produced by AI (upper panel) (Fujimoto, et al.)

### ● AI algorithm of generative adversarial brain

We develop efficient AI algorithms with the generative adversarial brain hypothesis, with interests in model-based reinforcement learning and imitation learning.

### ● Robotics with generative adversarial brain

We apply the AI algorithm to human-harmonic robotics, with interests in biped/quadruped robot controls in real-world multiple-task environments.



grasp   transition   walk

Figure 3. Robotics Research   We implemented a series of walking, motion transition, and grasping on the simulator, whose sequence was produced by AI (Hwang, et al.).

## Expected Research Achievements

### ● Goal of Research

We elucidate computational mechanisms of generative adversarial brain of human and primate, develop new brain-based AI algorithm, and examine its utility by applying it to human-harmonic robotics in the real-world.

### ● Outreach of Research

Our progresses can contribute, in the future, to developments of AI/robotics that support super-aging society and technology to assist communication/learning in individualized communities, and understanding psychosis that may hinder social activities.



Generative adversarial brain

Human-harmonic robotics

Elucidation of animal's transfer learning and meta learning

AI and robotics to support super-aging society

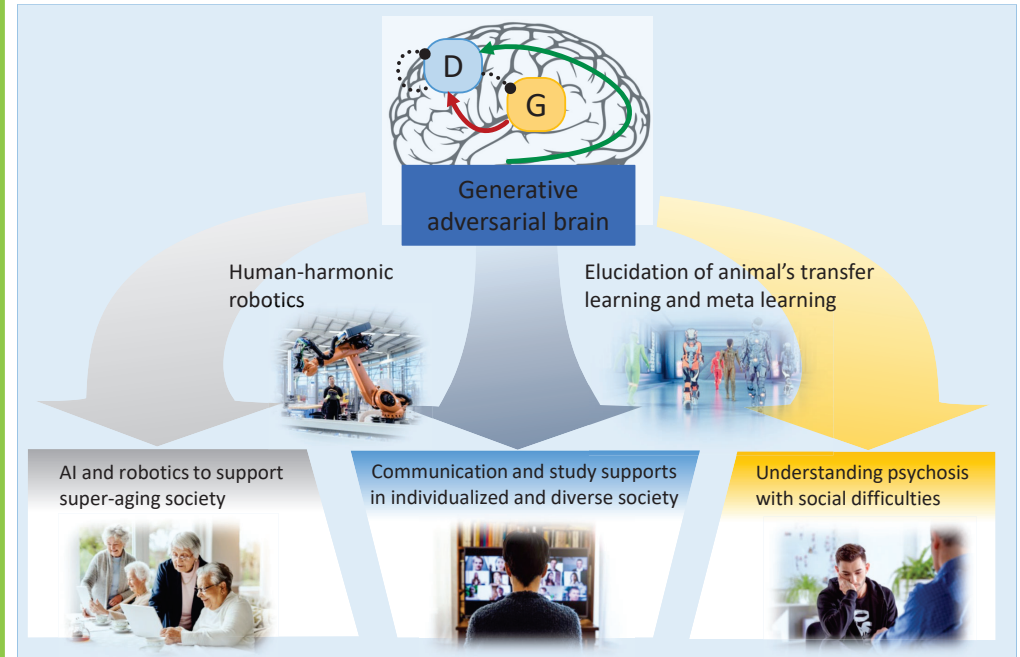Communication and study supports in individualized and diverse society

Understanding psychosis with social difficulties

Figure 4. Outreach of research

| Homepage Address, etc. | http://ishiilab.jp/member/ishii/ |
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