論 文 の 内 容 の 要 旨

論文題目　Statistical Mimesis from Partial Observation
and its application to Humanoid Robots
(部分観測情報からの確率的ミメシスとそのヒューマノイドロボットへの応用)

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This dissertation aims to design humanoid intelligence. Among various issues on humanoid intelligence, this dissertation focuses on development of humanoid's onboard intelligence. Humanoid's onboard intelligence means that a humanoid can recognize and estimate human's actions with its onboard vision systems in daily life, without using artificial markers.

Currently, most motion recognition researches use motion capturing systems. In the case of optical motion capturing systems, humanoid cannot communicate with a human outside of a motion capture room and a human demonstrator is required to wear a marker attached suit. In the case of wearable capturing systems, a human demonstrator is required to wear the system, which consists of many gyros. Hence, in above cases, it can be said that a humanoid interact with a human indirectly by receiving perception information passively from the external motion capturing systems.

In order to achieve humanoid's onboard intelligence, this dissertation includes (1) symbolizing human motion during interaction, (2) recognizing human behaviors from partial observation, (3) imitating congruent motions to the observation including invisible parts, (4) converting symbols into different spaces, and (5) localizing relative human position with respect to humanoid in the statistical and mathematical framework, which is inspired by the biological discovery of mirror neurons.

With the fast proto-symbol acquisition, mimesis model's three functions are possible during human-robot interaction. By adopting the fast training method, when an untrained motion pattern is observed, mimesis model recognize that it is a new motion and starts on-line proto-symbol acquisition.

By motion recognition from partial observation and motion generation conditioned by observation, it becomes possible to imitate a whole body motion from partial observation and to generate close motion to the observation.

With symbols conversion method into different spaces, it becomes possible to nonlinear mimesis problem from partial observation, such as 3D motion imitation from watching 2D images using a monocular camera on a humanoid. In the scheme, positions and postures of a humanoid and a demonstrator are not pre-requisite. From two-dimensional image sequences of demonstrator's motion, the humanoid can generate its joint motor commands for imitation in 3D space.