Session Overview
Learning and Adaptive Behavior

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In the evolution of robotics, robots have been increasingly operating in a variety of environments, unstructured, and dynamically changing over time. It has been clear since the first progresses of advanced robotics how the capability of perceiving the environment and of behaving accordingly is critical for robots.

Learning and adaptive behavior are therefore basic capabilities for most categories of robots, being them applied in services, in assistance, in autonomous tasks.

Though different in shape and functions, most robots share a common mechatronic structure, which integrates mechanisms, actuators, sensors, electronics, control, and power supply. Such structure interacts on one side with the external world and with a human user, on the other.

Learning and adaptive behavior is first of all needed for (autonomous) interaction with dynamic environments.

Considering the closer and closer interaction that robots have with human beings, learning and adaptive behavior is becoming increasing important also in the interaction with the human user. Robots are going to become more similar to personal assistants than to appliance, and a fruitful interaction requires that the robot and the user know each other, learn each other's habits and preferences, and adapt to each other.

Finally, biological inspiration in robotics is leading to complex structures with many sensor and unconventional actuators. Still following a biological inspiration, learning often plays an important role in the development of sensorymotor coordination on such structures. Furthermore, leading-edge research is also investigating the development of mechatronic structures that can change over time and evolve, so that it is required that robots have the capability to adapt to the modifications of their own bodies.

The papers in the ISRR 2005 session on "Learning and Adaptive Behavior" presented new advances in different aspects of this area.

The first paper, "Semantic labeling of places", by Cyrill Stachniss, Oscar Martinez Mozos, Axel Rottmann, and Wolfram Burgard, presented a novel

approach to classify different places in the environment of a mobile robot, into semantic classes. This approach was successfully validated both in simulation and with real robots. The algorithm developed by the authors allows a mobile robot to identify typical environmental places, like rooms, hallways, doorways, and other, and to classify them into semantic classes. The robot thus gets the capability of interpreting its operational environment and also to share semantic knowledge with human users.

The second paper, by Yasuo Kuniyoshi, Shinsuke Suzuki, and Kyosuke Shiozumi, presented "Emergence, Exploration and Learning of Embodied Behavior". In this case, learning is adopted to control a complex musculo-skeletal system. A novel model is proposed for dynamic emergence and adaptation of embodied behavior, based on a number of chaotic elements, each driving a muscle with local sensory feedback. The results obtained with a simulation confirm that modeling the musculo-skeletal structure as a couple chaotic system allows to obtain emergent ordered patterns that correspond to motor coordination patterns, able to re-organize in response to environmental changes.

The session was closed by the paper "Extracting places and activities from GPR traces", by Lin Liao, Dieter Fox, and Henry Kautz. The authors presented a novel approach to extract, simultaneously, activities and places of a person, from GPS data. Learning is used to identify patterns of human behavior, which may results useful in a variety of human-robot interaction contexts.