

2012 Robotics Seminar (1) / Japan Council of IFToMM

Date/Time: Friday, July 6th, 2012, 13:00-14:30

Place: University of Tokyo, Hongo Campus, Engineering2, Room31B

Host: Prof. Yoshihiko Nakamura (nakamura@nsl.t.u-tokyo.ac.jp)

Formal Approach to Robot Programming

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This seminar will introduce different views of robot programming and on that basis it will explain the benefits of the formal approach to the development of robotics software. Subsequently the formal approach will be formulated. Robot programming methods strongly depend on the structures of the robot control systems, so this lecture also deals with structuring robot control systems. The control system is decomposed into distinct agents. An agent, in general, is responsible for control of its effector, perception of the environment for the purpose of its effector control, and inter-agent communication. Moreover, it has a certain task to fulfill. The behaviour of the agent is governed by its set of transition functions, terminal and initial conditions. Transition functions take as arguments the information obtained from the components of the system. Those components that directly interact with the environment (i.e., receptors and effectors) enable the system to execute specific tasks in the environment. To do so the agents execute their prescribed behaviours. Those behaviours are defined in terms of transition functions. The duration of each behaviour is governed by its associated terminal condition. The selection of behaviours for execution is governed by initial conditions. Thus the behaviours are assembled into a finite state automaton to realize the task. The control system consists of two tiers - the upper tier is defined by the flow of information between the agents and the lower tier is defined by formal specification of each agent's behaviour (influence on the environment, gathering sensor readings, production and consumption of the information for/from the other agents). The formal considerations will be illustrated by one of the examples of utilization of this approach. Moreover, the structure of the MRROC++ robot programming framework, which stems from this formalization, will be discussed.

About Speaker: Cezary Zielinski received: M.Sc./Eng. degree in control in 1982, Ph.D. degree in control and robotics in 1988 and D.Sc. (habilitation) degree also in control and robotics in 1996, all from Warsaw University of Technology (WUT), Faculty of Electronics and Information Technology, Warsaw, Poland. He is a professor of WUT employed by the Institute of Control and Computation Engineering (IAIS). His research interests focus on robotics in general and especially include: robot programming methods (robot programming languages and robot programming frameworks), multi-robot system controllers, robot kinematics, robot force control, visual servo control, utilisation of sensors in robot control, behavioural and hybrid (behavioural-deliberative) control of robots, general purpose programming languages, mechatronics, design of digital circuits. He is the author/coauthor of 150 conference and journal papers concerned with the above mentioned research subjects.