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MODULAR ROBOTS ON MULTIAGENT PRINCIPE

The article describes how modules can be interconnected in terms of their architecture. Combining the principles of modularity and multi-agent management raises a number of advantages especially when operating these robots. This Vlasnost is common in nature where samoopravit'el'nost', substitution, etc. are commonplace. By adopting this theory, design direction, which gives the robot a new quality, which is based on the possible effective reconfigures its kinematic and functional structure, and thus using the original robot modules to create new variants of the robot with the required new parameters and behavior.

Keywords: *service robots, modular robots,multiagent robots.*

Introduction to the topic

Mobile robotic systems group is a group of mobile robots (agents) who are able to move independently in the environment and time. The individual robots in the group are able to communicate and coordinate their actions, but are not mechanically connected. They highlight the robotic industry, combining in itself Slot intelligent control systems (artificial intelligence) with the most modern automatic propulsion systems, so that they are in the environment always able to independently meet the required task, even assuming having overcome some obstacles. The emergence of such robots allows extensive interdisciplinary cooperation, which usually includes Mathematics, Physics, Mechanical Engineers and possibly biology. The application of this theory and the theory of modular robotics opens up a host of new architectural concepts of robots.

Multi agents principes of design

In a modular robot system, each module is usually equipped with its own independent computation, sensing, communication, and actuation capabilities and can thus be viewed as an independent agent. Each module can usually also send messages to other modules that are physically connected to it. Modular robots have three main advantages over traditional robots. They are capable of changing their configurations to become different structures or shapes based on deferent tasks.

In design the robot through each module is to be understood as defined agent. Most commonly cited definition Wooldridge and Jennings, which distinguishes the so-called agents, strong and weak, the weak agent is defined as:

computer hardware or software system that meets the following requirements: Autonomy: the agent acts without any direct human intervention or other and have control over their actions and internal state social ability: agents interact with other agents (or humans) via some communication language reactivity: agents perceive their surroundings (it may represent the physical world, the user - through a graphical interface, a team of agents, Internet or combination of them), and in due course respond to changes in their environment pro-activity: conduct of agents is not a simple response to ambient conditions, but can be and goal-oriented with taking the lead.

Heterogeneous multi-agent systems consist of different types of individual agents, so the robot will consist of various modules - which are autonomous agents. In such systems, each agent or group of agents have specific specialized tasks. In nature, many examples of such heterogeneous systems. Multi-cellular organism, wherein each cell has its specific task and all the cells together to form a complex being. It looks as though a team of specialists works much more effectively than the people broadly aimed at solving a complex problem. Heterogeneous systems are more efficient due to the fact that they can decompose the problem into individual parts. The drawback of such heterogeneous systems is that each agent has a different behavior, fig. 1.

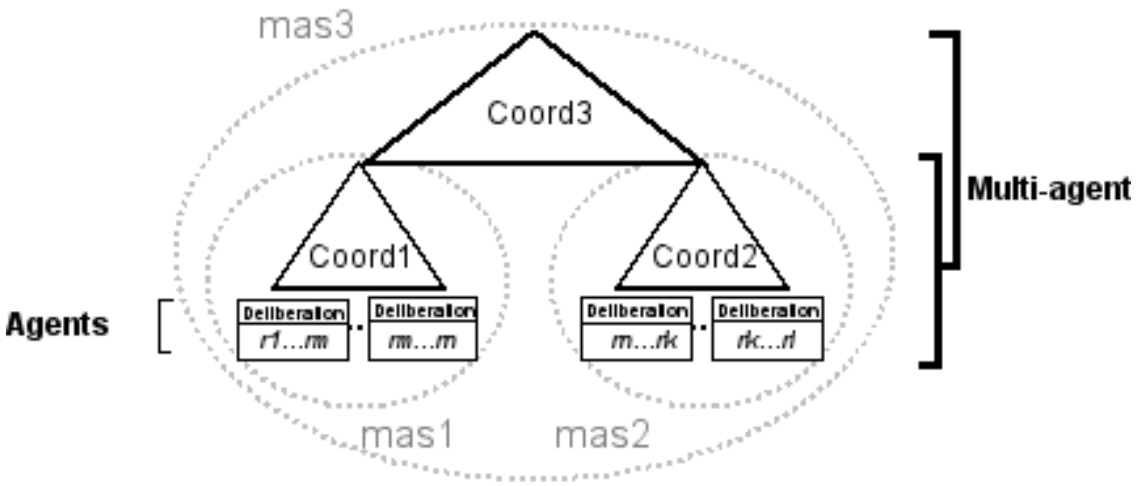

Fig. 1 Diagram of a multi-agent system

Multi agent systems originated as an extension of the field of distributed artificial intelligence which allows understanding the individual modules as independent agents. By adopting this concept, design direction, which gives the robot a new quality, which is based on the possible effective reconfigure its kinematic and functional structure, thereby taking advantage of the original robot modules generate new variants of the robot with the required new parameters and behavior.

Theoretical and design approaches to the solution of metamorphic service robots. It gives selected specific questions and problems connected with its design and construction. While various decentralized algorithms have been developed in the field of modular robotics, most approaches lack theoretical treatment; furthermore, most are specialized for particular tasks and dificult to generalize to other modular robot tasks or configurations. Theoretical understanding allows us to identify the scope of this approach and to further generalize it to a broader application area.

The problem of the design and application of modular robot has become a highly recent topic for theoretical as well as practical robotics. It echoes the dynamics of the service robotics development and searching new technical designs of the modular robot construction for the applications into non-traditional, demanding environments. The trends of the application of metamorphic – self-regulating structures in the design of mobility of modular robot subsystem, on the base of existing results and their evaluation, have proved technical usability and suitability to design new requirements on modular robot. So it can be concluded that the problem of modular robot has the reason to be solved also in our conditions.

Modular robotics

Theoretic robotics characterises metamorphic robots as modular systems with the ability to self-reconfigure their own kinematics and functional structure to create a „new“ robot with different functional features and technical parameters flexibly.

One of the main functions of robots is the locomotion function, i.e. mechanic relocation of MSR within some space. Robots movement is understood as the change of status in the space (position and orientation) of mobile robots. Robots Relocation into the status B in relevant (referential) space Z is the demonstration of certain type of relation of the movement M in the space Z.

$$M(B;Z) = \vartheta \quad (1)$$

Reconfigurable MSR (metamorphic MSR – MMSR) are based on modular structure, Fig. 2, i.e. on the set of autonomous modules AM (set of locomotion, mechanical, control, modules) and their mutual organization and connections. By the change of mutual organization (serial, parallel, combined structures) and the connection of AM it is possible to construct

different functional and kinematics (open, close, combined kinematics chains) of the robot configuration.

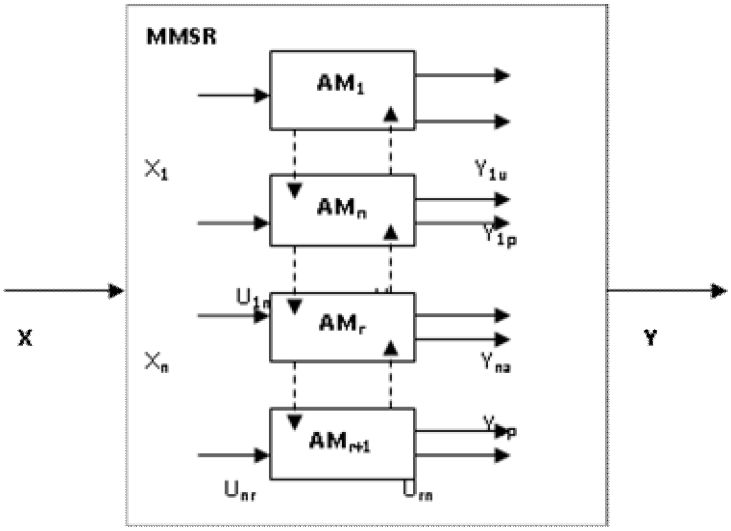

Fig 2 System setting of modular structure

The inputs into the module AM_{r+1}, Fig. 3, are the following: parameters X of the task of MMSR transformed into the parameters X_{r+1} of the partial task of the module X_{r+1}, parameters of compatibility U_{rr+1} transformed as the interaction of directly connected following module AM_r in the structure of MMSR. The outputs from the module AM_{r+1} are the following: output parameters Y_{r+1u} a Y_{r+1p} of the module AM_{r+1} representing fulfilling of the partial task of the module transformed into the output parameters Y of the robot MMSR, parameters of compatibility U_{r+1r} by which the module AM_{r+1} directly influences directly connected following module AM_r in the structure of MMSR.

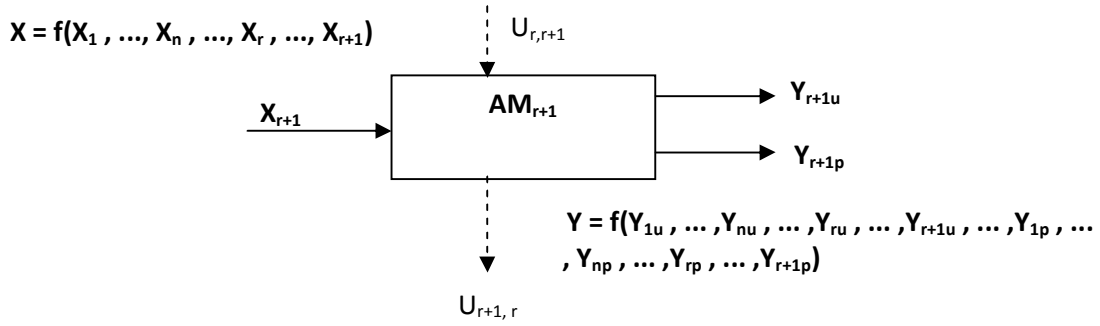

Fig 3 Module characteristics

Module AM is defined as a unified structurally, functionally and construction ally independent unit (constructed from the elements E; mechanic module, servo drive, or also the source, control and communication module) with given level of function integration (main, secondary, help) and intelligence (control – integration, control and decision-making function), with the ability to connect mechanically and to control other modules into functionally superior wholes.

$$MMR_{\psi} \approx \sum_{j=1}^{a} AM_j \approx \sum_{j=1}^{a} \sum_{i=1}^{e_j} E_{i,j} \tag{2}$$

From the point of view of the application, metamorphic structures can be applied on the level of the inner structure of MMSR(by reorganizing its own modules, the robot can change its kinematics structure, functional structure and disposition setting, functional features and technical parameters), or on the level of outer structure of the application of robotic system

(simple robots integrate into one, functionally higher level robot or a complicated robot disassembles into a group of simple, more active and more effective robots).

Conclusion

The problem of the design and application of modular has become a highly recent topic for theoretical as well as practical robotics. It echoes the dynamics of the service robotics development and searching new technical designs of the multi agents systems construction for the applications into non-traditional, demanding environments. The trends of the application of multi agents systems structures in the design of robot susbsystem, on the base of existing results and their evaluation, have proved technical usability and suitability to design new requirements on robot.

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