Editorial

The idea of publishing an issue of *Journal of Automation, Mobile Robotics and Intelligent Systems* devoted to the design, modelling and control of robots emerged in the discussions during the 11th National Conference on Robotics organized by the Department of Fundamental Cybernetics and Robotics, Institute of Computer Engineering, Control and Robotics, Wrocław University of Technology in Karpacz, Poland from 9th till 12th of September 2010. This conference showed that the Polish robotics community has produced significant results in this field, and thus the Program Committee decided that it would be beneficial, if those achievements would be put together within one publication, so that they could complement each other. Hence a selected group of authors working on design, modelling and control methods in robotics was invited to submit papers describing their research results. It should be underscored that the papers contained in this issue of JAMRIS are by no means a simple translation into English of the conference papers. Here the reported results have been described more comprehensively and in wider context, and subjected to the regular JAMRIS review procedure. Gratitude should be expressed to all of the reviewers who provided in depth comments enabling many clarifications and overall improvement of the contents of the papers.

Ten papers compose this issue. These papers have common features that enable us to treat them as a single, unified thematic group. All of them pertain to certain aspects of designing a robotic system, hence, if our purpose is the creation of a complex robotic system, we need to take into account all of those aspects. The first and foremost is the idea standing behind the mechanical structure of the system. Then a certain model of that system has to be established. The purpose of that is the elaboration of the control algorithm and the computer simulation of its performance unveiling the properties of the proposed system. Next, the motion planning has to be taken into account. Finally, the experiments proving the correctness of the proposed approach have to be executed. The collected papers address all of those subjects.

Dexterous grasping of both rigid and floppy objects is at the center of attention of the robotics researchers. Here, the research is concentrated both on a novel gripper design, and on the control of those devices supplemented by the grasp planning. The design of a multi-fingered hand is addressed by the paper entitled *Functional characteristics of a new special gripper with flexible fingers*, authored by Krzysztof Mianowski. A major problem in grasping is establishing contact between the fingers of the gripper and the acquired object. The location and the dimensions of the latter are usually known only approximately, thus some form of compliance has to be included into the mechanism. A control algorithm itself is not sufficient, if fast motions are to be attained. To some extent, the design of the mechanism must be such that compliance will be due to its elasticity, however the precision of positioning should not be sacrificed. A novel passive compliance mechanism that provides the estimate of the applied force and compliance is presented in this paper.

Motion of manipulators in constrained spaces requires miniaturization of their drives. The paper entitled *The servo drive with friction wheels*, is the work of Łukasz Frącczak, Leszek Podsędkowski and Marcin Zawierucha that focuses on motion transmission utilising friction in laparoscopic devices. This solution leads to the miniaturization of the servo drive, what is of utmost importance in the case of laparoscopic instruments operating in very constrained spaces. The paper presents the general idea of friction motion transmission, the proposed design of the mechanism, including proprioceptive sensing, and the control method.

Operation within human body requires the manipulator to be coated with an antiseptic skin. This type of coating adversely influences the motion capabilities of the manipulator. At the focus of attention of the paper entitled *Mathematical model of a multi-link surgical manipulator joint with an antiseptic coating*, by Ryszard Leniowski and Lucyna Leniowska, the model of the manipulator joint and practical aspects of its control are written, taking into account both the extremely high gear ratio used and the friction and damping introduced by the antiseptic coating. The model of the coating is of paramount importance from the point of view of the control algorithm.

Non-holonomic devices usually employ a reduced number of actuators in comparison with the number of dimensions of the space that they act in. Non-holonomic mobile platforms have been studied in depth, but non-holonomic manipulators are a novelty. A non-holonomic gear utilising friction transmission is the topic of the paper entitled *Modelling and experimental research of nonholonomic ball gear*, contributed by Bartłomiej Krysiak, Dariusz Pazderski and Krzysztof Kozłowski. Modelling and experimental results provide information on the maximum driving torque and gear efficiency that can be provided by such a device as well as the resultant slip that can occur due to the application of excessive torques.

The use of passivity in robot control is perceived as an advantage that can lead to a considerable reduction of energy requirements. This excites the interest in all aspects of the utilisation of passive joints. Motion planning taking into account friction in the passive joints of a manipulator is the subject of the paper entitled *Motion planning of the underactuated manipulators with friction in constrained state space*, produced by Adam Ratajczak and Mariusz Janiak. The imbalanced Jacobian algorithm, derived from the endogenous configuration space approach, is utilised in the motion planning task for an underactuated manipulator with passive joints, both exhibiting friction and frictionless. The simulation experiments demonstrate the effectiveness of the proposed approach.

Control of mobile platforms and manipulators treated separately has received considerable attention. Control of those devices in conjunction is not that well studied, especially if both subsystems are non-holonomic. Superiority of kinematic feedback control over kinematic open-loop control of a non-holonomic manipulator mounted on top of a non-holonomic platform has been proved in the paper entitled *Different kinematic controllers stabilizing nonholonomic mobile manipulators of (nh, nh) type about desired configuration*, provided by Alicja Mazur, Joanna Płaskonka. Simulation experiments have underscored the advantages of the proposed feedback control method. The non-holonomic platform and the non-holonomic manipulator are being controlled by separate kinematic controllers. The choice of the kinematic controller for one subsystem affects the behavior of the other subsystem due to high dynamic interactions. Nevertheless, the kinematic feedback is able to cope with such a disturbance.

The majority of papers devoted to the control of non-holonomic mobile platforms assumes that the constraints imposed on the motion of their wheels are not violated. However, the paper entitled *Motion planning of wheeled mobile robots subject to slipping*, created by Katarzyna Zadarnowska and Adam Oleksy assumes a more realistic stance and takes into account that slip is a natural phenomenon in the motion of those devices. Slip is modelled as a small perturbation of the ideal constraints. The motion planning algorithm, derived from the endogenous configuration space approach, uses the linearization of the control system representation of the system's kinematics and dynamics along the desired trajectory. Simulation experiments demonstrate that the proposed approach is viable.

The paper entitled *Real-time obstacle avoidance using harmonic potential functions*, authored by Paweł Szulczyński, Dariusz Pazderski, Krzysztof Kozłowski, deals with the mobile platform motion planning by means of harmonic functions. The method uses analytical description of the solution to Laplace equation. The algorithm takes into account elliptically shaped static obstacles. Simulations affirm that the method ensures the collision avoidance and the convergence to the goal. The superiority of the proposed method in relation to other potential field methods is due to the reduced curvature of the resulting trajectory.

The solution of the above mentioned path planning algorithms requires the knowledge about the terrain that is to be traversed, i.e., its map is needed. The paper entitled *Terrain map building for a walking robot equipped with an active 2D range sensor*, written by Przemysław Łabęcki, Dawid Rosiński and Piotr Skrzypczyński addresses this subject. Perception of rough terrain and its mapping is at the focus of attention of this work. Two walking robots equipped with inexpensive optical range sensors providing 2D data are the devices utilised in the experiments. Structured light sensor and a laser scanner are also used. Although the laser scanner is superior in delivering accurate measurements, the structured light sensor is much cheaper. The discussed on-line mapping algorithm includes a provision for removing map artifacts that result from the qualitative errors in range measurements.

If a robot is to act in a changing environment, it should be capable both of quick perception and fast planning of its activities. The time of processing the sensor data is crucial. The paper entitled *A mobile robot navigation with use of CUDA parallel architecture*, written by Barbara Siemiątkowska, Jacek Szklarski, Michał Gnatowski, Adam Borkowski and Piotr Węclewski delves into the problem of parallelization of 3D laser scanner image processing for the purpose of map building. The proposed path planning method utilises the structural similarity between a cellular neural network and a graphic processing unit in order to find a collision free path within the map. The experiments confirmed that due to the employed parallelization the path planning problem can be solved quickly enough that the mobile robot controller use it in real-time.

All of the enumerated topics are at the forefront of the currently ongoing research into robot design, modelling and control. Each of the papers gives a valuable insight into a particular problem, providing its formulation and deriving a solution. This selection of papers reveals the wide scope and diversity of contemporary robotics.

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