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Work seminar entitled: “Robots for micro-nano technological operations” 2010

held in Bakadzhitsite, Bulgaria.

within the frame of the national conference with international participants

“Mechanisms, mechanics of the machines, Machine building and energetic technologies”

MMMMET 2010

Hotel Jambolen, 25 – 27 June 2010

The purpose of the Hydromel Work seminar on Robots for micro-nano technological operations was to provide opportunities for scientists and engineers in Mechatronics, Robotics and Biomechanics involved in the FP6 Hydromel Project to present the results obtained and discuss current research, as well as to exchange new ideas, and establish a basis for future collaboration. Another goal of the seminar was to present the Hydromel project results to a broader society of specialists in mechatronics and robotics, mechanisms, mechanics of the machines, machine building and new technologies.

The FP6 Hydromel **Work seminar “Robots for micro-nano technological operations”** was held June 26 2010 within the frame of the National conference with international participants “Mechanisms, mechanics of the machines, Machine building and Energy technologies”, 25-27 June 2010, Bakadzhitsite, Bulgaria with a total number of more than 100 participants.

Bakadzhitsite is a chain of low hills which belonging to the geological Srednogorie as it stretches east of the river Tundzha, about 15 kilometers from the city of Yambol. The conferences took place in the hotel “Jambolen”. There were 4 main groups of paper reporters: theoreticians and experimentalists, designers, technologists and industrial users.

Hotel Jambolen - Bakadzhitsite, hosted the Hydromel work seminar on Robots for micro-nano technological operations

Prof. **Veselin Pavlov,** the Conference chairman, opened the work seminar and gave the floor to assoc. prof. **Ilia Roussev** who introduced to the conference participants the Hydromel project and the Bulgarian participation.

Then, Dr. **I. Ivanov** made a presentation "*Milestones in robotic injection of cell cultures*". Some cell cultures like suspension, adherent and other cell cultures were presented. The stages of robotized injection of cell cultures were outlined and structured.

The next presentation "*Visual servoing of a robotic cell injection system"* by assoc. prof. **I. Rousev** treated an experimental study of two techniques in the field of visual servoing. An approach to facilitate the injection micropipette point detection, focalizing and tracking was developed. A deliberate investigation was performed to solve the problem of automatic pipette integrity detection. Blue laser light and LED were used in both techniques.

Assoc. Prof. I. Roussev presented his paper at the work seminar

Assoc. Prof. **I. Roussev** presented the next study "*Force sensor for biological and industrial micro/nano applications*", too, where MEMS force sensors with sub-micro-Newton resolution were treated emphasizing on their advantages for many scientific, industrial, and biological applications in the field of micro/nano-technology. A detailed investigation and calibration of the prototyped force sensors and an innovative idea about their interaction with interface providing soft receptive layer were also disclosed.

The paper "*Teleoperation controlling and sensors in micro and nano scale*" by Ph.D. student **D. Penchev** discussed the main principles and approaches for teleoperation control of robots for micro – nano- technological operations. Appropriate types of sensors for micro and nano scale and their basic circuits were analysed for possible applications in the NSF project SpeSy-MINT.

Dr. Vl. Kotev spoke on "*Structural synthesis and kinematics of hybrid macro – micro robots*", outlining some problems of the synthesis and kinematics of hybrid macro – micro robots with close kinematic chain. Macro and micro accessible areas and transfer ratios of five links manipulating system were determined. It was shown that structures of manipulation mechanisms would change according to the activation of macro motors or micro actuators. In both cases micro operations were performed by short-range movements.

Prof. **P. Genova** tackled "*Synthesis of hybrid macro- micro – robots by the methods of kinematic geometry*". A methodology for the synthesis of planar linkage manipulation mechanisms with linear part of its trajectory was proposed. Two principally

different problems, considering mechanisms with two degrees of freedom, were solved with the implementation of the methods of kinematic geometry. The first one was a direct problem of kinematics – how to find Boll's point for a given mechanism configuration and a given transfer ratio of the velocities at the two inputs. The second problem was the inverse one – how to find mechanism kinematic parameters for a given Boll's point.

Prof. P. Genova presented her paper at the work seminar

Prof. **P. Genova** also gave a talk on "*Deformation analysis of specialized grippers for manipulation with micro and nano objects and tools*". An analysis of deformations, micro displacements, degree of freedom and loading of a gripper for clamping cylindrical objects was performed by the finite element method.

Assoc. Prof. D. Chakarov presented his paper at the work seminar

The final paper "*Two ways of the modeling and analysis of a serial – parallel micro manipulator with elastic joints*" was presented by assoc. Prof. **D. Chakarov.** A piezo actuated micro robot with a serial – parallel structure including elastic joints was considered. A CAD and kinematics models and calculations with finite elements were presented in order to estimate the values of the mechanical parameters. The stiffness of principal components of the robot structure was evaluated using pseudo rigid body approach where elastic joints were modeled as revolute ones.

There was a discussion after the presentations. Various ideas on synthesis, design, kinematics, dynamics, modeling, control and manufacturing of the hybrid macro and micro robots for micro and nano technological operations were expressed. The employment of those robots in different fields, such as microelectronics, micro biology and chemistry etc. was discussed. Attention was paid to accuracy of robot position, displacement, hysteresis, sensors, and control.

All 8 presented papers were accepted for publication in a special volume of the journal "Mechanics of the Machines", issuing by the Publishing house of the Technical University of Varna, ISSN 0861 – 9727.

Contacts and information:

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