PREFACE

Contemporary robotics may be regarded as a research activity within the area of science and engineering aimed at designing machines able to act autonomously in diverse, often unknown or dynamically changing environments. Like many other complex scientific fields robotics is interdisciplinary; it makes use of several classical disciplines of science and scientific methodologies spread out from formal logic and mathematics up to mechanics and computer science.

In this special issue entitled **Mathematical Methods in Robotics** we have undertaken the task of revealing to the Reader, at least partially, the mathematical face of robotics. This issue contains 10 invited contributions prepared by distinguished roboticians addressing various aspects of mathematical modelling and mathematical analysis of robot kinematics and dynamics as well as of robot control. Both rigid and flexible manipulation robots are considered as well as mobile robots. The mathematics involved comes from analysis, singularity theory, calculus of variations, dynamical systems and geometric control.

To characterize the contents of this special issue we want to make the following comments. There are 4 articles dealing with the robot kinematics. A. Maciejewski and R. Roberts have addressed the problem of optimal design of the manipulator's kinematics, preserving the manipulator's dexterity in spite of possible mechanical failures of the joints. M. Galicki presents further results on optimal redundancy resolution in manipulators, obtained by the application of constrained variational optimization methods. The article by J. Kieffer and that by K. Tchoń concentrate on mathematical analysis of singularities of manipulator's kinematics, and on the singular tracking problem. Two articles included into this issue contribute to mathematical modelling of the manipulator's dynamics. The text by W. Beres and J. Sasiadek offers a comprehensive account of a mathematical approach to modelling flexible link manipulators. The article authored by K. Kozłowski studies the problem of increasing the computational efficiency of models of the manipulator's dynamics, paying special attention to so-called diagonalized Lagrange equations. The last group of 4 articles refers to the subject of robot control. The work by A. Loria and R. Ortega presents new control algorithms: for rigid manipulators, that uses velocity estimation, and for manipulators with flexible joints, that does without measuring jerks at the joints. H. Nijmeijer and H. Berghuis have introduced and proved semiglobal stability of new control algorithms for rigid manipulators; furthermore, they have made an attempt at extending the classical

Lyapunov analysis to the tracking of chaotic trajectories. P. Müller proposes a practical tracking algorithm for flexible joint manipulators whose novelty lies in estimating the model's nonlinearities accompanied with disturbance decoupling. Eventually, the article by G. Campion, G. Bastin and R.E. Mahony describes new algorithms of position and orientation stabilization of 3 d.o.f. wheeled mobile robots regarded as non-holonomic control systems.

To end with the preface the guest editors wish to express their genuine gratitude to all the authors who have contributed to this issue. It was an honour and pleasure for us to cooperate with them. Special thanks are also directed to Prof. J. Korbicz, the Editor-in-chief of Applied Mathematics and Computer Science, for his initiative of preparation this issue, as well as for his constant encouragement and active assistance while this issue was being produced.

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