RZESZÓW UNIWERSITY OF TECHNOLOGY **Rzeszów, 2021**

Faculty of Mechanical Engineering and Aeronautics

Department of Applied Mechanics and Robotics

DIPLOMA THESIS ABSTRACT

Kinetics of cooperative robots

Author: Wincenty Skwarek

Supervisor: dr hab. inż. Andrzej Burghardt

Key words: large-size transport, mobile robots, robots formation kinematics, Denavit-Hartenberg notation, modeling of dynamics

Abstract

The doctoral thesis presents the methodology of building mathematical models of the formation of mobile robots in large-size transport. The first chapter of the work contains a review of the literature related to the subject of research, the formulated aim and scope of the work as well as the genesis of the problem. The second chapter presents the methodology of building mathematical models describing the formation kinematics of robots transporting objects. Groups of two and four robots with a generalization to n robots were considered. The kinematics of two robots transporting the beam was also described with the method of fixing the beam, allowing for singular configurations in the inverse kinematics task. The built models were simulated in the Matlab/Simulink package. The third chapter describes the dynamics of the system of two-wheeled mobile robots cooperating in the large-size loads transport by two and three two-wheeled robots. The purpose of modelling such a system was to obtain a mathematical model in an appropriate form. The Lagrange equations of the second type were used to describe the dynamics, and then the projection method was used to eliminate Lagrange multipliers. Thanks to this approach, unknown dry friction forces at the contact points of the robot's wheels with the ground were eliminated from the description, and the dynamics in controlled coordinates was obtained. In addition, the obtained model has structural properties that enable its use in the synthesis of a control system based on a mathematical model. The obtained mathematical models were simulated in the Matlab/Simulink package and also verified on real objects. The work ends with a summary, conclusions and an indication of the direction for further research.