Summary

The subject of this dissertation is the problems connected to modeling and dynamics research, stability analysis and optimization of the duty cycle of a mobile crane.

The work was divided into seven Chapters that included the Introduction, Literature Review, Aim and Scope of the work, three main Chapters on the implementation of the set goal and scope of the work, and the Conclusions. In addition, the work was supplemented with a list of symbols, a summary in English and Polish, and lists of literature, figures and tables.

Chapter four (the first fundamental) presents the problem of modeling the load dynamics carried by a mobile crane. The scope of the work included the modification of the existing theoretical model of load motion by taking into account the spherical motion of a rigid body and the impact of wind pressure. The proposed modification made it possible to carry out a series of simulation tests describing the change in the trajectory of the transferred load. The influence of external forces on the fluctuations of the transferred load and its final positioning are described.

The fifth chapter discusses the problem of loss of mobile crane stability on the basis of the proposed theoretical model and with the use of SolidWorks software. The causes of loss of crane stability and different methods of its determination were characterized. A test stand for a laboratory crane was designed and built to enable verification of the obtained numerical results. Various sequences of crane movement, as well as the weight of the carried load were analyzed. It was determined in which cases the crane will experience a temporary loss of stability, collapse and remain stable.

The sixth chapter presents the process of optimizing the duty cycle of a laboratory crane, in which the minimization of the trajectory of the carried load was selected as the objective function. The research was carried out using the genetic algorithm (GA) and particle swarm optimization (PSO) method. The influence of particular algorithm parameters on the obtained optimal solution was characterized. For the best obtained result, the inverse kinematics problem was solved, allowing to determine the positions of individual crane members.

The last chapter summarizes and presents a proposal for further research stages as well as the possibility of using the proposed models and algorithms.