N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 1, Number 427 (2018), 111 – 117

UDC 621.01

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THE DESIGN OF UNIQUE MECHANISMS AND MACHINES. I.

Abstract. This work is devoted to the development of numerical methods of calculating the kinematic and dynamic parameters for the design of a new mechanism of class IV based on equations kinematics and dynamics. Kinematic and dynamic models of these mechanisms are described by differential-algebraic equations. These equations are singular differential equations. For the first time, we consider the analysis of dynamics and kinematics for mechanisms of high class in a joint formulation. A cardinal breakthrough is possible in the transition of mechanisms of lower class to high class to design new mechanisms and machines. A new concept based on Runge-Kutta method is offered for mechanisms of high class aimed at solving kinematic - dynamic model. Methods, algorithms and programs are developed to define the position and the speed of links for mechanism of class IV at any given accuracy. A numerical experiment has shown a huge advantage of mechanism of class IV to design a new mechanism for mechanical engineering and robotics.

Keywords: kinematics, dynamics, mechanism of high class, mechanical engineering, robotics.

Introduction. The modern theory of analysis and synthesis for lever mechanisms of lower class (class II) is complete and theirfeatures are studies and used in practice. Therefore, a significant breakthrough in the design of new machinery and equipment is possible in the way of upgrading the facility.

The exploration of mechanisms of high class was started with well-known Assyria's work [1]. Academicians Artobolevsky I.I. [2], Zholdasbekov U.A. [3] and a lot of other scientists made their contribution into the further development of the theory of those mechanisms. In these works, the benefits of mechanisms of high class compared with mechanisms of lower class (class II) were established based on geometric and approximate methods.

The kinematic-dynamic model for mechanism of highclass is described by differential-algebraic equations (DAE).Some questions of the investigation of DAE are given in [4-6].

The complete analysis of mechanisms of high class involves the simultaneous solution of kinematic and dynamic problems. According to the classical theory of mechanisms and machines,a separate solution of complex problems is considered. Planar lever mechanism of class IV as the basic mechanism out of all mechanisms of high class and in much the same way a four-link mechanism out of mechanisms of lower class II are going to be studied.

This work is devoted to the development of a new calculation theory for the underlying mechanism of class IV done based on the theory of differential equations.

In the second part of this work, we consider singular differential-algebraic equations and a power analysis of these mechanisms.

The proposed methods, algorithms and the held computational experiment made possibilities to identify the unique characteristics of the above mentioned mechanism of class IV and their use in various scientific and technological fields (in the mechanisms like departure chassis of an aircraft, load-lifting cranes, presses, robots and other devices).

The common model for mechanism of high class. Suppose the mechanism of high class (MHC) consists of n moving links. Numbers of output links vary from 1 to n-m, and the number of input ones