

# **Analysis and Simulation of Stewart Platform Manipulator Behavior Driven by Pneumatic Cylinders Applied in Wood Processing**

**Novak NEDIĆ, Ljubomir LUKIĆ, Dragan PRŠIĆ,**

**Vladimir STOJANOVIĆ, Duško DUBONJIC\***

*\*University of Kragujevac, Faculty of Mechanical and Civil Engineering in Kraljevo  
Dositejeva 19, 36000 Kraljevo, Serbia*

E-mails: [@mfkv.kg.ac.rs](mailto:nedic.n, lukic.lj, prsic.d, stojanovic.v), [duka4cz@gmail.com](mailto:duka4cz@gmail.com)

**Abstract.** Modern development of machine tools includes investigation of advantages of machines based on a parallel kinematic structure with multiple degrees of freedom. Hence, Stewart platform based on a parallel kinematic structure with six degrees of freedom, achieved with six cylinders pivotally connected to the lower fixed plate and the upper moving plate, is gaining in importance. The advantage of this structure is greater stiffness and accuracy, smaller drives, etc., but smaller workspace. The wood processing industry increasingly requires performing complex spatial forms with high accuracy whose forming occurs at high speeds. Since environmental, energy and maintenance requirements become stricter, the pneumatically driven Stewart platform becomes more and more interesting. The problem of air compressibility and achieving complex trajectory of high static and dynamic accuracy as well as repeatability with high speeds becomes an important factor in understanding the development and selection of robotic platforms. These requirements unavoidably look for understanding kinematics and dynamics of new machines including their drives, and then control algorithms. The paper focuses on analysis and simulation of the behavior of these machines, i.e. realization of the exact position of the moving plate as a base for high quality woodworking. Particularly for processing large and complex products. The analysis is based on the formulation of Lagrange equations of the second type, determining the Jacobian matrix for mechanical part and forming models for the pneumatic actuator (cylinder + valve). The simulation is performed using the MATLAB/Simulink software. Input signals of valves are formed on the basis of desired position of the plate for the chosen platform and drives. The machine is characterized by a larger working space, i.e. longer working strokes of pneumatic cylinders. Hence, it will be considered the impact of the complexity of the desired trajectory platforms, stroke lengths, speed, compressibility etc., on the accuracy of achieving the position of the platform.

## **1 Introduction**

Development of machines based on platforms with parallel mechanism is essential in the development of the wood industry. Industrial robot is a reprogrammable multifunctional manipulator designed to move and process material (wood), through various programmed movements, in order to perform desired tasks. The main disadvantages can be overcome by using parallel manipulators, enabling the most

























