Paper ID: 55818
student

Key Technologies (7)
Robotics, Human-Machine Interaction (2)

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COLLABORATIVE ROBOTICS IN AEROSPACE MANUFACTURING: ASSEMBLY PROCESSES ROBOTIZATION

Abstract

The research considers the concept of a transformable assembly system with the use of collaborative robotics for aerospace industry. The manufacturing of spacecraft hull structures is highly labor-intensive process, in particular the drilling and riveting works. This article describes the paradigm of transformable assembly systems aimed at creating the basis for autonomous context-dependent and adaptable assembly systems that can be developed together with products and processes. One of the key technologies in the development of the transformable assembly system for aerospace manufacturing is the use of collaborative robotic complexes. Collaboration is a state in which purposely designed robots work in direct cooperation with a human within a defined workspace (ISO 10218). The essence of proposed solution is in the cooperation between worker and collaborative robot within the framework of one technological process – drilling and riveting of hull structures during spacecraft assembling. The collaborative robot performs the most of monotonous operations, the worker is involved when performing operations in a work area inaccessible to the robot. Such a combination allows to reduce the total time on the operation and reduce their total labor intensity with minimal interference in the existing technological process. The simulation model for labor intensity estimation was developed: it is a game-based model, that allows to calculate operational time for different scenarios of human-robot interaction. The most advantageous is their simultaneous work in the shared workspace. In this scenario human and robot are considered as an absolutely equal participants of manufacturing processes, able to perform similar operations. Simulation is based on simplified matrix representation of a spacecraft part under processing. The issues of adaptation of collaborative robot for changes in work environment according to the human actions are the most critical. Proposed solution allows for combining the benefits of manual labor flexibility and the performance of automated. In the future it is planned to consider cellular automata for representation of the part matrix and to form rules of dynamic sharing of the joint human-robot workspace from the point of view of cyber-physical system.