

SECTION 9.

AUTOMATION AND APPLIANCES MAKING

Vladyslav Yevsieyev 

Doctor of Engineering Science, Professor, Professor of Department of Computer-Integrated Technologies, Automation and Robotics
Kharkiv National University of Radio Electronics, Ukraine

Dmytro Gurin 

Senior lecturer of the Computer-Integrated Technologies,
Automation and Robotics Department
Kharkiv National University of Radio Electronics, Ukraine

STUDY OF METHODS OF DYNAMIC DESCRIPTION OF THE ENVIRONMENT FOR COLLABORATIVE ROBOTS-MANIPULATORS IN THE CONCEPTS OF INDUSTRY 5.0

The relevance of the study of methods of dynamic description of the environment for collaborative manipulator robots in the context of Industry 5.0 is due to the need to create interactive, intelligent and adaptive production systems. Industry 5.0 is focused on human-robot interaction, where collaborative robots play a key role in increasing the productivity and flexibility of production processes. Given the rapid changes in the environment in which robots operate, it is important to develop effective dynamic description methods to ensure the safety and accuracy of human interactions. Such methods allow robots to quickly adapt to changing conditions and unpredictable situations, which is critical for reducing risks when working together with operators. In addition, the development of robotic systems in the concept of Industry 5.0 contributes to achieving a higher level of automation, personalization and integration of cyber-physical systems, which emphasizes the importance of research in this area. The main methods of dynamic description of the environment of collaborative work within the concepts of Industry 5.0 are presented in Figure 1.

The methods of dynamic description of the environment of the collaborative robot ensure the ability of the robot to adapt to the changing conditions around it, respond effectively to them and ensure safe interaction with a person. Given the specificity of cooperation with people, such robots must use complex algorithms to analyze the environment in real time and make quick decisions.

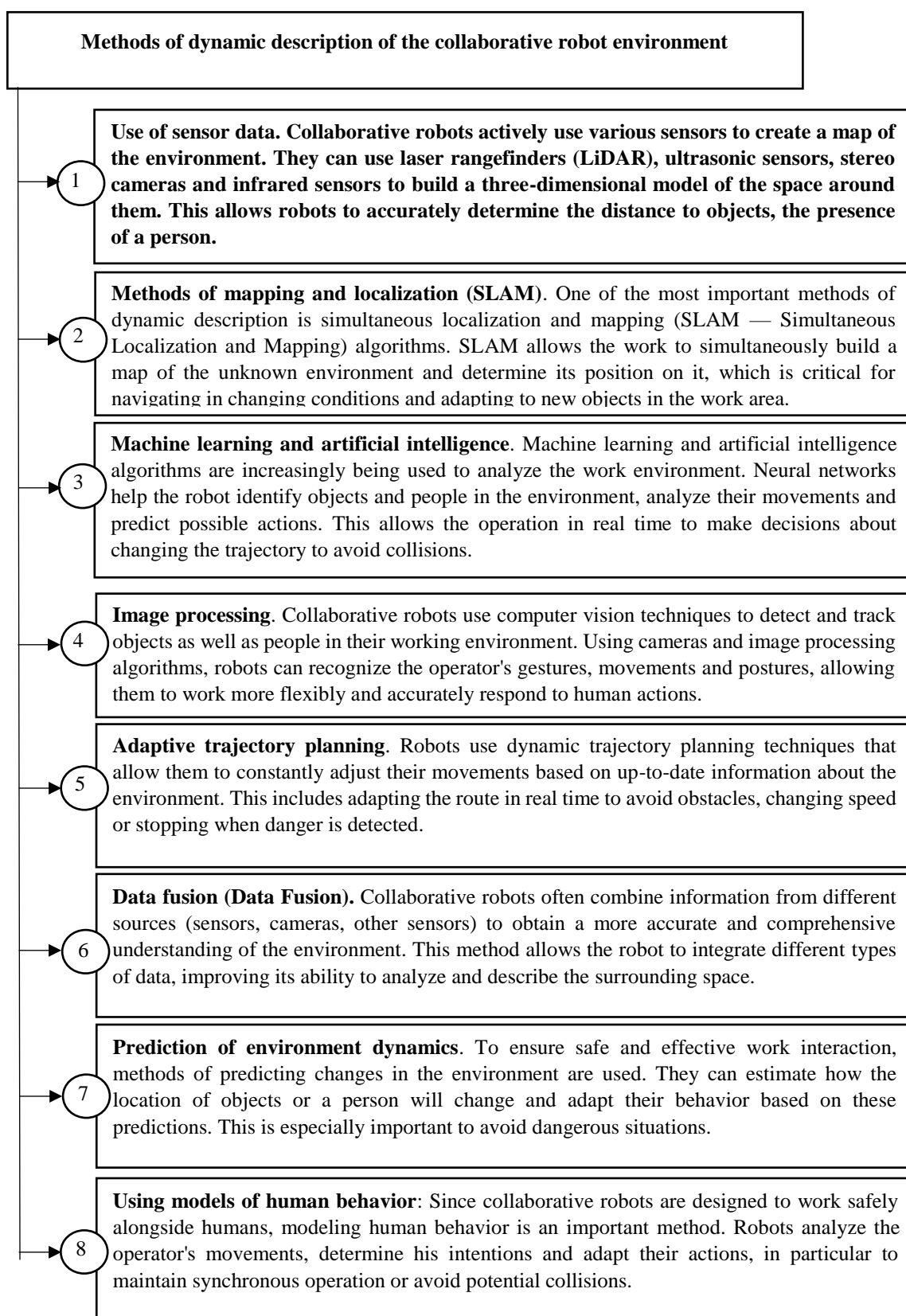


Fig. 1. The main ones methods dynamic description surrounding environment collaborative work within concepts Industries 5.0

Collaborative works are actively used different methods for dynamic description environment, each from whose has your advantages and disadvantages. We will conduct analysis of each method and reveal their advantages and disadvantages from the point sight use to describe dynamic surrounding environment kolbota.

Using sensory data is one of key methods that allows robots to navigate in space and find obstacles Laser range finders (LiDAR), ultrasonic sensors, stereo cameras and infrared sensors create three-dimensional model of the space around the robot. The advantage of this approach is high accuracy in definition distances to objects and fast detection obstacles, however the cost of such sensors can be high, and their work in conditions of dust or reflections sometimes gives false data.

Methods simultaneous localization and mapping (SLAM) is extremely effective for construction maps a new environment, allowing work at the same time to map space and determine actually position. This is especially useful for navigating the unknown or variables conditions. However, SLAM requires large computing resources resources, and in environments with many moving objects algorithms they can lose accuracy that maybe slow process adaptation of the robot.

Machine learning and artificial intelligence algorithms provide robots with the ability to identify objects and people in the environment, predict their actions and make decisions to avoid collisions. Such algorithms enable robots to operate in complex environments, but require significant resources to train and tune the models, which can be a time-consuming process. In addition, the quality of recognition largely depends on the quality of the training data.

Adaptive planning trajectory provides permanent adjustment based on robot movements relevant data about the environment. It increases efficiency work in variables conditions and allows quickly respond to the appearance obstacles. However this method can need complex calculations that slows down process adoption decisions in real time. Merger data from different sensors improves precision analysis because integration different types information allows avoid false conclusions. But it also increases complexity system and its computer requirements resources.

Predicting the dynamics of the environment allows robots to estimate how the location of objects or people will change, and to adjust their behavior in advance. This is critical for security, but the accuracy of predictions depends on the quality of the input data and algorithms. Using human behavior models is another important technique for collaborative robots that work in close proximity with operators. Analyzing a person's movements, the robot can predict their actions and avoid

possible collisions. At the same time, misinterpreting the operator's intentions can lead to undesirable results, especially in critical situations.

Conclusions. In the course of research, modern methods of dynamic description of the environment for collaborative manipulator robots in the context of Industry 5.0. it was found that the adaptability and safe interaction of robots with humans are key aspects for increasing the efficiency of production processes. The use of dynamic description methods allows robots to quickly respond to changes in the environment and ensure reliable collaboration. The importance of further research in this field is confirmed by the trend towards deeper integration of robotic systems into cyber-physical production processes.

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