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COMBINED APPROACH TO AUTOMATED SELECTION
OF ROBOTIC MECHANICAL ASSEMBLY TECHNOLOGIES ON THE SET OF LOCAL DISCRETE CRITERIA

At the current stage of robotics development and its application in modern machine assembly technologies, a significant place is occupied by the problem of optimizing its different components, which are necessary when projecting/synthesizing robotic mechanoassembly technologies (RMAT) that are implemented in flexible manufacturing cells.

Having no unified method or approach to choose an optimal RMAT for today, which for example, would combine minimizing of economic costs and expenses used AC with enough high technical performance, makes it necessary to further research this scientific area.

One of the important issues in modern engineering practice is the choice of RMAT on the set of local discrete criteria that constitute the set of their (technologies) manifestations: Gm – geometric, Kn – kinematic, Dn – dynamic, Ct – control, En – energetic, Tr – trajectory, τ – time, which determine certain kinds of productivity Q, Rl – the indicators of reliability, Ec – economic, Ac – accurate, Fc – force.

This set of RMAT local criteria in some way reflects a number of technical and economic criteria, such as: maximum of productivity; decrease of the cycle duration of technological influence on the object of production; minimum changeover time for manufacturing other products; maximization of equipment usage coefficient; optimization of movement of robotized technological kit; trouble-free trajectories; required accuracy; the number of positioning points, which are functions determined by geometric parameters of industrial robots units; process equipment units, industrial robots dexterity and gripper; route of technological influence on the manipulation object.

To solve the problem of choosing an optimal RMAT it is desirable to consider simultaneously each of the discrete local criteria. Nevertheless, in practice, this is not feasible, because some indicators are ranked as the criteria, and others are ranked as limitations set.

To determine the priority in typical problems of vector or multicriteria optimization, numerous approaches are used which foresee a wide usage of the following methods:

1. random search method, the main lack of which is the absence of scientific basis for systematic technologic decision-making (STDM);

2. activity based costing (ABC) method, the main lack of which for solving this problem is a long and expensive process of data collection for carrying out the analysis. In the result we can get too detailed information which can essentially complicate the process of RMAT selection;

3. expert judgments method, which involves reworking of experts information according to certain methods.

The expert judgment that was conducted at the Automated Control of Technological Processes and Computer Technologies Department at Zhytomyr State Technological University revealed no consistency among experts for RMAT selection based on the preliminary evaluation of each of the local criteria. It is explained by incomplete knowledge or lack of necessary information, unreliability of knowledge, which is characterized by the presence of subjective and objective uncertainties, etc. Moreover, the complexity and difficulty of each RMAT manifestation does not allow to accurately assess a criterion defining the advantage of its manifestations in a particular set of analyzed criteria. Thus, unreliability and inaccuracy of existing knowledge of available factors greatly affect the result.

To solve the problem, in which input data are not clearly defined and weakly formalized the fuzzy sets and fuzzy logic are used successfully. The mathematical theory of fuzzy sets allows to submit vague concepts and knowledge, to operate them and to make fuzzy output. Fuzzy logic provides effective means of mapping uncertainties and inaccuracies of the real world. It is closer to human thinking and natural language than traditional logic system and this gives it some flexibility.

To answer the question how input data interact in the course of fuzzy calculations, the Analytic Hierarchy Process method is widely used and it allows us to find the best alternative on the set of discrete local criteria, considering the interaction of pairs and combining some important end-result displays in hierarchical clustering.

Another known method that can be used to solve these problems is the group method of data handling (GMHD). It allows to reduce the solution of multivariable problem to solving a large number of relativity simple tasks.

To sum up, it is worth mentioning that the method of an automated RMAT choice on the set of local discrete criteria is developed at the Automated Control of Technological Processes and Computer Technologies Department at Zhytomyr State Technological University. It systematically takes into account the benefits and peculiarities of fuzzy sets, fuzzy logic, GMDH and AHP. Such integration of famous methods determines consistency in decisions STD and reproduces the content and nature of ultimate goal of the automated RMAT selection on the set of local discrete criteria.