3D ROBOT MODEL AUTOMATIC MODIFICATION

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Abstract: *At present the most of world producers have been forced to use maximally the newest technical knowledge and tools for the both new product development or existing ones innovation. The high efficiency is reached with computer aid of the flexible assemblies creating built up on the unified modular components base. The article is aimed at the effective utilisation of CAx system Pro/ENGINEER tools for modification of robot 3D models creating. There are shown possibilities of the robot 3D model automatic modification through the controlling program which had been created in Pro/ENGINEER environment.*

Key words: *robot, automation modification, Pro/ENGINEER, modularity of robots*

1. INTRODUCTION

The present situation in prominent world countries is possible to characterise as a period of microelectronics and microprocessors penetration into all industry branches. The technical progress is accompanied by growing product complexity. There is the pressure to short both development and production times of the product in required quality and with costs minimisation [4]. The present customers do not satisfy with mass manufactured product. These facts lead to looking for means for engineering works rationalisation. This problem was solved by computer aided systems. For the first, CA systems were utilised for administrative activities. Now they present the top software which contribute to the productivity rising and enable to give flexible response on the varying customer requirements [7].

At the present engineering plant CA systems represent a significant mean for solving of all tasks practically. Most of all are applied in pre-production stages. CAx systems can support the complex solution of part or production device development, design and production very effectively [1]. CAx systems effectiveness heightens effectively when they are components of integrated unit with possibility to access to information of individual databases. CAx systems tools support the application of Concurrent Engineering (CCE) ideas into the complex

products development [7]. CAx systems influence so important factors as “Time to Market” and total production costs [5].

Robots are very complex mechatronics devices, which are designed for the specific applications. Robots development trend is based on the modularity principles. Modular construction is created with connecting of the self-contained structural units and modules. Individual modular components are characterised by unified connecting elements. They do not need additional project and mounting activities only activities connected with an assembling. If the plant production program get change, the construction of modular robot is possible to modify relatively in the short time. Variability of the modular robot structure solutions enable to realise a wider assortment of this one types [3].

2. PROGRAM FOR AUTOMATIC MODIFICATION OF THE ROBOT 3D MODEL

Robot as a technical unit is very complex device. The development of this one needs teamwork of specialists from the construction, technology, control and other domains. The problem of robot automatic modification we solved out only for robot action subsystem. The program for control of the component automatic interchange in robot 3D model was verified for robot of kinematics structure shown in Fig. 1. This is the robot of modular construction designed on the base of FESTO unified components. CAx system Pro/ENGINEER was used for robot 3D model designing. The program for control of 3D model modification was created with help of Pro/PROGRAM. This tool of system Pro/ENGINEER enables to control creating of the parts or assemblies by the parameter models data editing. We can design models with

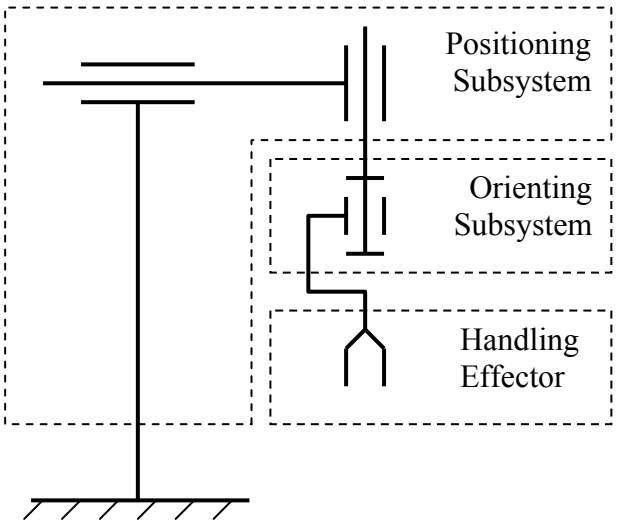

Fig. 1. Robot kinematics scheme and subsystems [2]

the similar characteristics and coming up to the structural criterions with help of Pro/PROGRAM utilisation. Every Pro/ENGINEER model consists of the information about main structural steps and parameters. We can edit this model description in such the way that this one will be to function as a "program". After program running we have to change the model according to the new structural task. The advantage of this program is the fact that this one run in Pro/ENGINEER environment directly.

From the reason of computer modelling the technical unit of the robot type representative was divided into individual function subassemblies. There the most important subassemblies are:

- Positioning subassembly (the positioning of manipulated object inside robot working space),
- Orienting subassembly (the orientation of manipulated object inside robot operating space) and
- Handling effector (the gripping of manipulated object).

The modular structure consists of the unified components, which have already functionally verified. Their technical parameters and properties have already known too. In designing offices 3D model of modular components are often comprehended in internal databases. The new robot kinematics variants designing or modification of already existing assemblies are time demanding. Therefore, the creating of the program, which controls the components interchanging in robot assembly, contributes to the designer skill activities automation and shortening of the design time creating too.

2.1. Creating of the program

The main assembly of the robot type representative (3D model) consists of both the active and passive subassemblies. Active subassemblies are created by translate and rotate drivers and effectors. Passive subassemblies are created by carrying and connecting components, screws etc. The robot type representative created in "Interchange Assembly" has to consist all components which can appear in 3D robot model. Every type of modular component is characterised by both the dimensional set (it is defined with help of "Relations") and technical parameters as working stroke, movement parameters, allowable loads etc.

The steps lead to the creating of program for the assembly component automatic interchange ability is possible to summarise into the next points:

- Creating of the database of the modular components 3D models for robot representative in Pro/ENGINEER environment – see Fig. 2.,

- Creating of dimensional sets (a relations defining) for all module types,
- Creating of the *main assembly* in Pro/ASSEMBLY,

Fig. 2. Some unified components of the robot representative type

- Creating of the single modules in Pro/ASSEMBLY (as "*Interchange Assembly*") – see Fig. 3.,

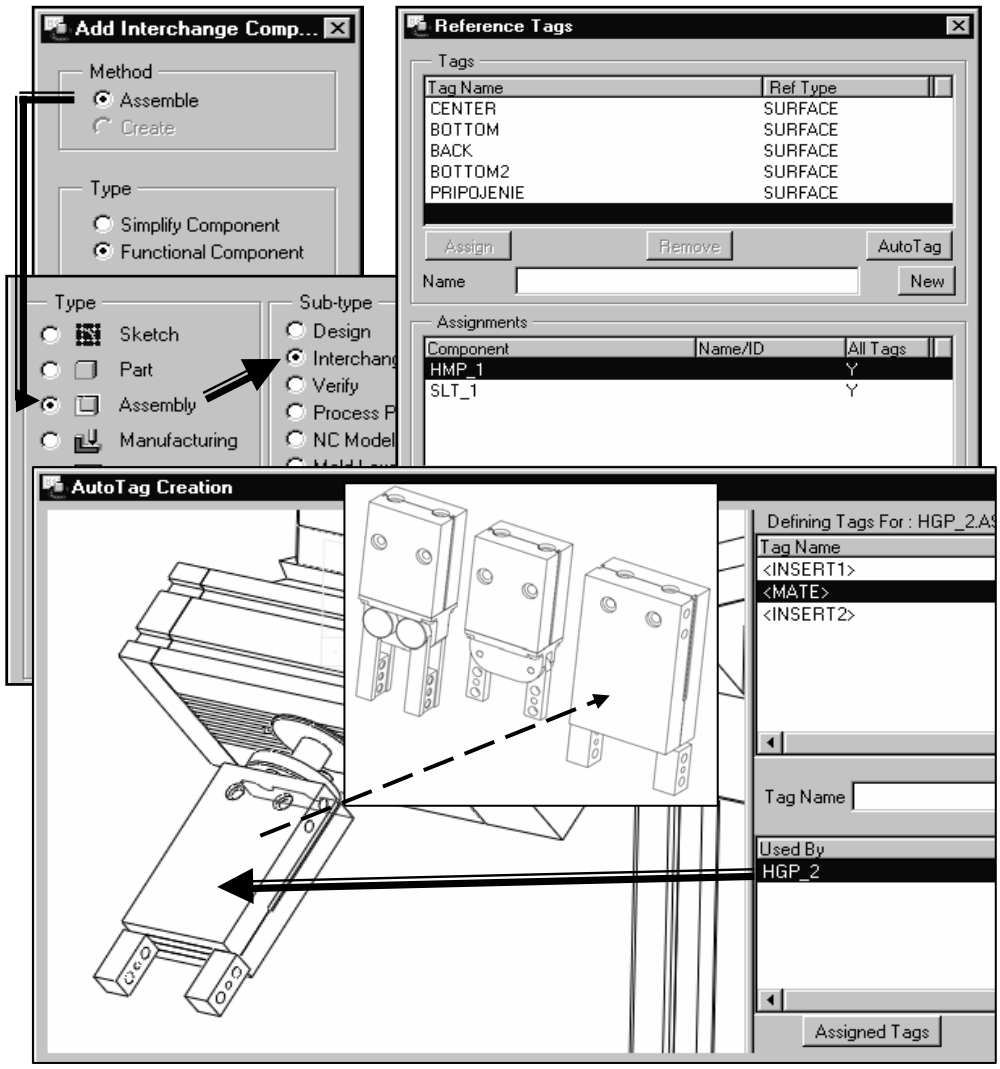

Fig. 3. Functional interchange assembly creating [2]

- Defining of "*Reference Tags*" for all robot type modules with help of *main assembly*,
- Creating of the controlling program for assembly modular components interchange ability (Pro/PROGRAM),
- Creating of Map Key buttons for program controlling,
- Defining of customer environment (own toolbar and icons for working with program) – see Fig. 4.

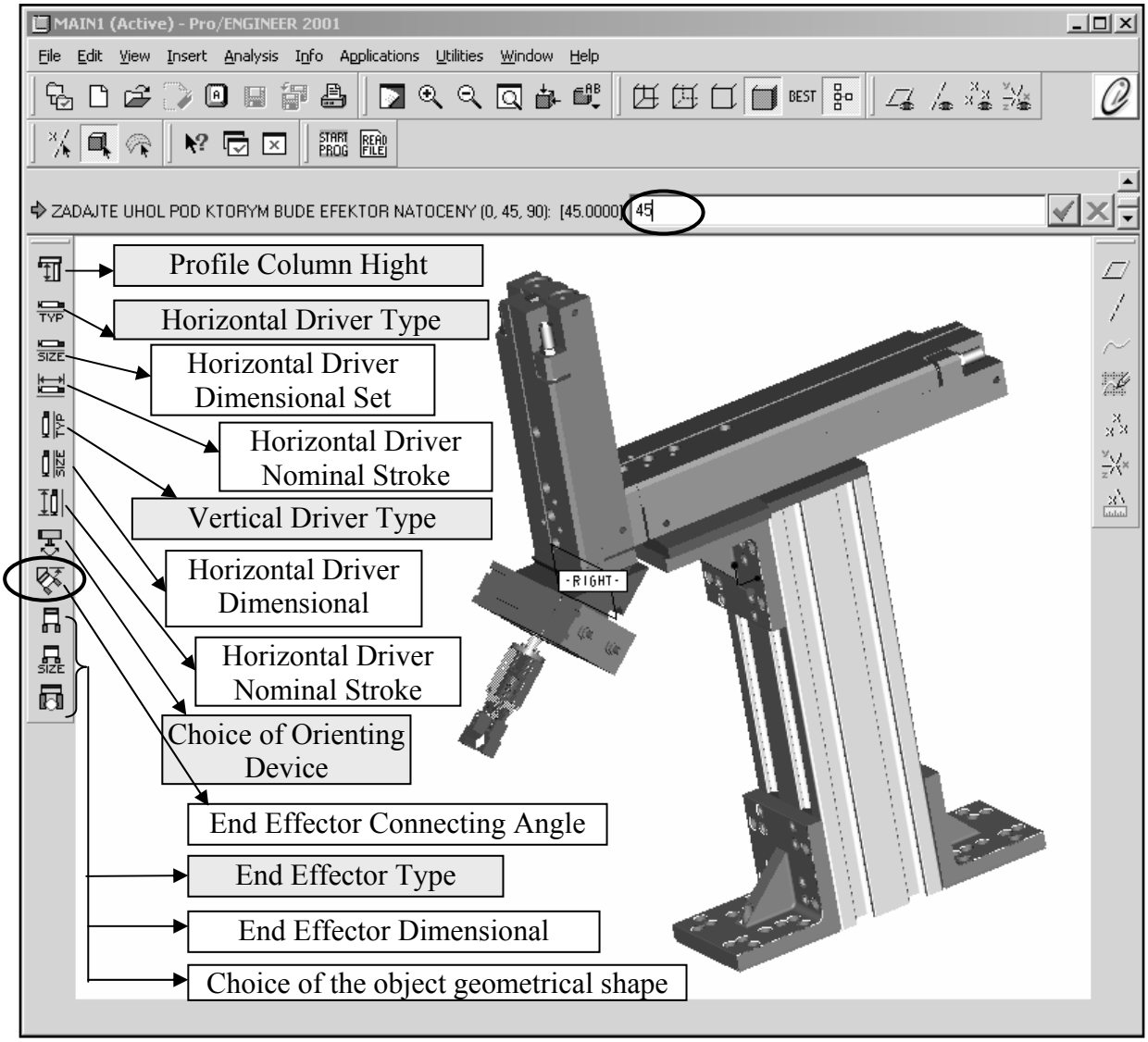

Fig. 4. The program screen with special toolbar

4. CONCLUSIONS

The program of robot 3D model automatic modification is the result of the diploma work solution [2]. There was created the database of 3D models of all modular components of which the robot type representative consists. The program control was created in

Pro/ENGINEER environment. This program controls the automatic modification of main assembly 3D model. The customer able to modify 3D assembly by activation of the tool bar icons which are displayed on the screen left side. The choice of the concrete unified component is realised through the dialog window. There the customer inputs the technical parameter value which is chosen from the offered scale of values. The new component is placed into the primary assembly component position exactly with keeping all options of the primary positioning. The program is suitable for creating of relatively quick modifications of existing 3D model robot. The created variants are some preliminary robot designs which able to be submitted to testing and optimization in Pro/MECHANICA Motion module. There is possible to obtain the information about new design functionality, speed parameters, working space, loads and important responses in mechanism. The designer works with "done" assembly and so he needs not to make model of the new robot variant so cumbersomely. Then he can dedicate more time to the robot design improving.

4. REFERENCES

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