COMPONENT BASE MODELS FOR WORKPLACE

Ľuboslava Šidlovská – Dominika Palaščáková

Abstract: A research center that is used to verify the identification of selected algorithms and methods for secure grip of components by industrial robot was created within the project of applied research at the department. It contributes to enhancing the effectiveness of palletizing - assembly cells.
Keywords: reverse engineering, scanning objects using laser scanner, 3D model

Analysis of components

Components (objects) that meet the following requirements are suitable for manipulating industrial robots:

- There is sufficient rigidity at the point of grip ,
- There is a simple symmetrical shape at the point of grip,
- Possibility to grip the object so that the machined surface does not get damaged,
- Possibility to grip the object as close as possible to the center of mass of the object,
- Possibility to grip the object with the clarity of the object position in space.

Cylindrical surfaces and plane parallel surfaces are most suitable for robotic manipulation according to the division of shapes. When creating a supply of components base analyzed the most important design features, such as: geometrical shape, dimensions, weight, materials, semi-finished and under. For technical data when assays component base most often analyzed types of technological operations and their labor content.

Cylindrical surfaces and plane parallel surfaces are best suitable for robotic manipulation according to shape classification. When creating the supply of components most important design features are analyzed, such as: a geometric shape, size, weight, material, semi-product, etc.

When analyzing the supply of components from the point of view of technical data, types of technological operations and their labor content are most often analyzed. BOMs (bills of materials), components´drawings, manufacturing processes, etc. represent the bottom line for analyzing the supply of components. Supply of components must be processed using CAD software in larger ensemble. Models of supply of component contain several groups of data.

1. The first group consists of data on the prevalence and nature of distribution of parts according to individual parameters.

2. The second group represents the group of balance data sheet. Component base model allows to determine the production capacity of the robot system for:

- Individual operations,
- Components,
- Workplaces and the entire production system.

3. The third group involves data for identification of the subjects of the supply of components. Analysis of the supply of components according to the general methodology must be supplemented by the following characteristics typical of robotic systems:

- gripped areas (shape, dimensions) – defined by the basic parameters for the construction of gripper,
- clamping surface of the positioning equipment – determined by the construction of clampers, pallets, conveyors, etc.,
- suitability for automatic orientability – determineed by therequirements for screening equipment,
- appropriateness of technological methods with regard to the method of fixing the object, relative position of tools and the object and accessibility of working space for the robot gripper,
- relations between handling and technological times,
- relations of labor content of individual operations - extreme differences in labor content of individual operations require large-capacity containers what causes problems.

The shape of the object of manipulation must provide the possibility of secure grip and repositioning by robot. Therefore the distance, alignment and parallelism of the areas and axes of the object of manipulation must be examined. Objects of manipulation are analyzed from the point of:

- Types of surfaces (external or internal, planar, cylindrical, etc.),
- Containment of surfaces defined according to whether the surface profile is heading into the free space or the material (open, semi-closed and closed areas),
- Surface orientation ,
- Surface location, which means the distance from the start of the selected coordinate system. It is determined by the distance of the nearest and farthest point of the surface.

Selected models of objects in 3D

A particular piece of the group of identical objects is selected for verification the algorithms of gripping steps of objects in different light conditions.

Selected object models include 2D – flat part and 3D – volume part objects. The objects are captured using a laser scanner. For the verification of the proposed solutions are used components necessary for building an electrical switch as the objects of manipulation.

A flat part depicted as No.1 and No.2 component. Component No.1 - it is a galvanized steel sheet with thickness of 1 mm and of the maximum dimensions of 24.4 x 22.2 mm. Model in a 3D view is located in Fig. 1.

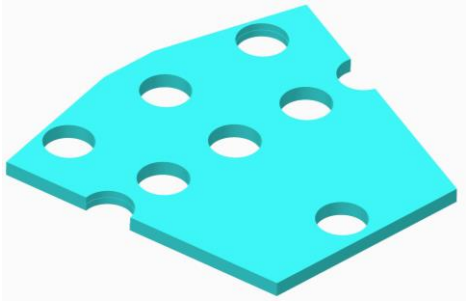

Fig. 1 Component No: 1 in 3D

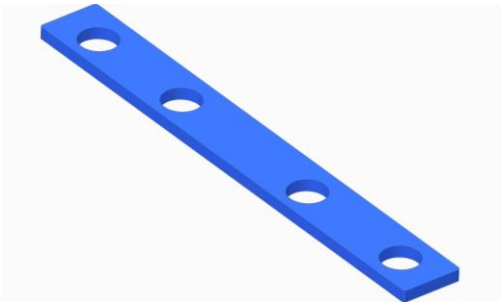

Fig. 2 Component No: 2 in 3D

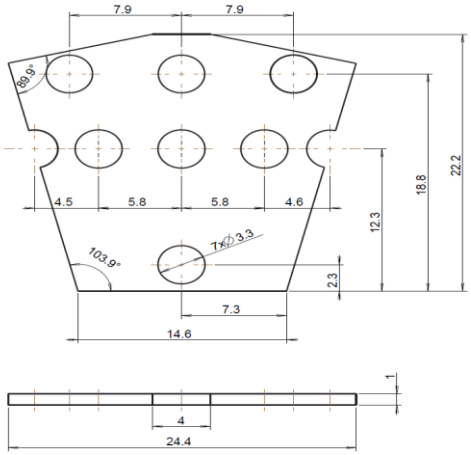

Fig. 3 Component No: 1 in 2D

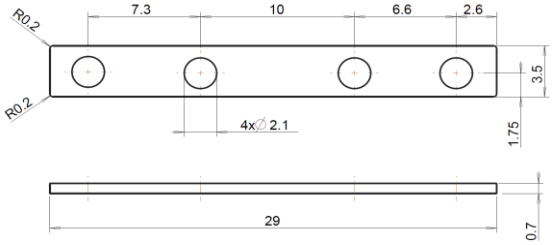

Fig. 4 Compopnent No: 2 in 2D

PART 2 - it is a galvanized steel sheet with thickness of 0.7 mm on the maximum dimensions of 29 x 3.5 mm. Model in a 3D view is located in Fig. 2.

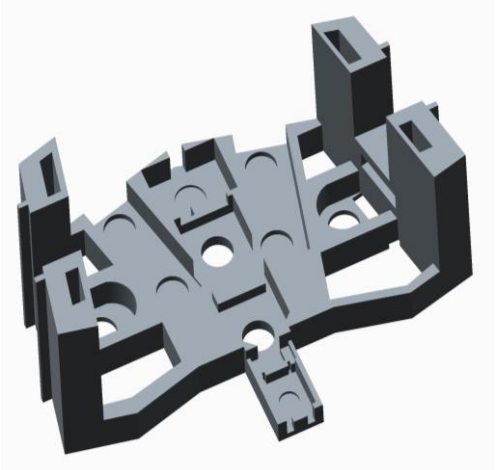

Fig. 5. Component No. 3 in 3D

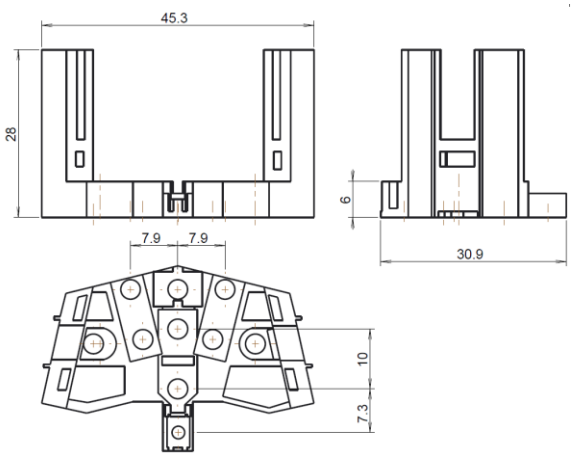

Fig. 6 Component No. 3 in 2D

View the printed components in 2D view created using CREO 2.0 environment is in Fig. 3 and 4. The volume part is a component object No. 3 - it is a plastic component produced using injection press with 28 mm height and maximum size 45.3 x 30.9 mm. Model in 3D is the fig.5 and 6. View the part No. 3 in 2D view created using CREO 2.0 environment is in Fig. 6.

View 3D model of the switch of verified parts depicted in fig. 7.

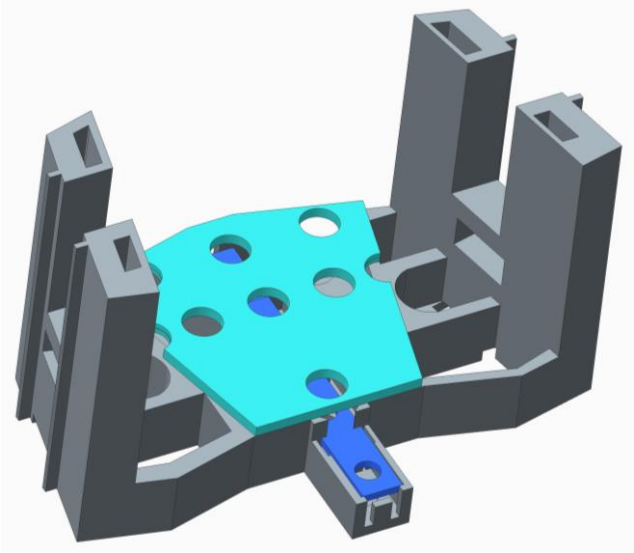

Fig. 7 3D view of the kit of switch

Palletizing objects may enter chaotically arranged, partially oriented, or exactly oriented. The first and the second case requires either a workstation fitted with the device using indicative various known principles of a given orientation, for example, the use of the Center of gravity, the mechanical constraints, etc., or a robot equipped with sensors for the analysis of 2D and 3D dimensions.

Conclusion

It is necessary to develop and increase the intelligence of cells in order to increase the efficiency of palletizing - assembly cells, which means the ability of cells to make decision independently on the basis of data obtained from different devices scanning processes’ flow in the cell.

This work was created as part of the project VEGA 1/0124/15 Research and development of advanced methods for virtual prototyping manufacturing equipment.

References

[1] P. Bigoš, M. Hajduk, L. Koukolová, P. Tuleja: Princípy a technické stvárnenie 3D skenovania objektov In: Robotics and Intelligent Manufacturing Systems: zborník príspevkov z medzinárodnej konferencie : 27. jún 2013, Košice. - Košice : TU, 2013 S. 25-30. - ISBN 978-80-553-1473-0

[2] M. Hajduk, Ľ. Šidlovská, P. Tuleja: Unilateral Gripping Mechanism Effectors, In: Applied Mechanics and Materials, Vol. 332 (july 2013), section OPTIROB 2013, Chapter 3: Robotics and Automation Systems, Control, pp. 181-185, Trans Tech Publications 2013, Switzerland, ISSN: 1662-7482

[3] L. Páchniková, R. Jánoš, Ľ. Šidlovská: Manufacturing systems suitable for globalized market. In: Applied Mechanics and Materials: ROBTEP 2012: 11th International Conference on Idndustrial, Service and Humanoid Robotics, Štrbské Pleso, Slovakia, 14-16 November 2012. Vol. 282 (2013), p. 230-234. - ISBN 978-303785603-1 - ISSN 1660-9336

[4] R. Rusnák, M. Vagaš, Ľ. Šidlovská: Kamerové systémy robotov In: Robotics and Intelligent Manufacturing Systems: zborník príspevkov z medzinárodnej konferencie: 27. jún 2013, Košice. - Košice : TU, 2013 S. 144-147. - ISBN 978-80-553-1473-0

[5] Páchniková L., Šidlovská Ľ.: Simulation as a support tool for design of manufacturing systems. In: Transfer inovácií. Č. 18 (2010), s. 209-212. - ISSN 1337-7094

[6] Ľ. Šidlovská, P. Tuleja: Application fields of scara kinematics type robots pursuant to their parameter, 1 elektronický optický disk (CD-ROM). In: Machinary, technology, materials : 7 international congress : May 26-27, 2010, Sofia, Bulgaria. - Sofia : Scientific-technical union of mechanical engineering, 2010 P. 110-112.

[7] Kováč J, Jánoš R.: Nové trendy projektovania výrobného systému In: International Scientific Herald. Vol. 21, no. 2 (2011), p. 136-140. - ISSN 2218-5348

[8] P. Dulenčin, A. Belovežčík, Ľ. Šidlovská: 3D model robota digitálnou fotogrametriou In: ROBTEP 2011: Automatizácia / Robotika v teórii a praxi: zborník príspevkov z 11. medzinárodnej konferencie: 16.12.2011, Košice. - Košice : TU, SjF, 2011 S. 75-78. - ISBN 978-80-553-0846-3

[9] Palaščáková D., Šidlovská Ľ.: Reliability of the production system in engineering production In: Monograph: Deterioration, Dependabillity, Diagnostics. - Brno : Univerzita obrany, 2015 P. 141-148. - ISBN 978-80-7231-431-7

Contact address

Ing. Ľuboslava ŠIDLOVSKÁ
Technical University in Kosice, Faculty of Mechanical Engineering, Department of Production Technique, Letná 9, Košice, Slovakia
e-mail: luboslava.sidlovska@tuke.sk