Design of Gripper Types for an Intelligent Manufacturing - Assembly Cell

Nina Danišová, Roman Ružarovský, and Karol Velíšek

Abstract—**This contribution presents the design of gripper types for an intelligent manufacturing cell. This manufacturing cell is situated at the Institute of Production System and Applied Mechanics. The complex design of gripper types is going out of the intelligent manufacturing systems knowledge. An automated exchange system with different types of jaws was designed for the intelligent manufacturing cell and at the end a sensorial system for the gripper buffers was designed as well. These sensors are used for the identification of jaws.**

KEYWORDS: **system, design, mechanics, manufacturing, jaw types**

I. Introduction

THE industrial manufacture is still forwarding. Today we are not talking only about using of IT, classical automated instruments. But when we are talking about flexible manufacturing systems, it is effective to talk about the possibility of using of new generation manufacturing systems. These new generation manufacturing systems are also called intelligent manufacturing systems. All IMS subsystems are including parts of so called machine intelligence (sensor equipment). Using of given systems with combination of machine intelligence will be lead to the complete laboratory remove from the manufacturing system. Monitoring systems are using sensors, which are located at some proper place of the system, usually such place is tool, machine or some manipulating device. Sensors are identifying parameters, which are then used as input data of control system. Following to this data is realized some, technological, manipulating or other helping process [1].

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II. Intelligent Manufacturing-Assembly Cell Characteristics

At the Institute of Production System and Applied Mechanics is situated flexible manufacturing cell "Fig.1". This flexible cell consisted of two subsystems:

1. Cartesian robot
2. Shelf storage system

Five working phases are integrated in the flexible manufacturing cell:

- storage (storage of semi products, final products before its expedition),
- transport and manipulation (transport and manipulation with semi products and final products),
- manufacture (manufacturing of single semi products - parts to the final product),
- assembly (assembly of single parts of the one final product),
- expedition,

Fig.1 Intelligent manufacturing - assembly cell

A very important part of the manufacturing cell is robot created from three axes, which are represented of three electrical driven actuators. Whole robot works at the Cartesian workplace. There are many elements, which are located at the work place of the robot.

- Special tool position used for automated tool changing system,
- Rotary unit,
- Pneumatic driven gripper,
- Grippers storage,
- AHC unit,
- Tools storage.

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Following of the conclusions and knowledge, which are coming from intelligent systems studies, were in the flexible manufacturing cell designed special added sensor units for each device. That means that every device will have its own sensor units, which will be used for processing of primal information. Such information ensures communication between single devices and control system. Before single sensor units specification, there was needed to specify requirements, which will be given to the designed intelligent manufacturing and assembly cell [3].

Main requirements used for intelligent manufacturing and assembly cell design following:

Designed intelligent cell would be able to react of various situations, which are coming during the manufacturing process. Such as:

- React to the change of shape of manufactured or assembled parts,
- React to the change of part dimensions,
- React to the usage or not usage of single subsystems by manufactured parts,
- React to the part types change,
- React to the change of technological parameters,
- Assurance of collisions situations at the cell,
- Low manufacturing costs,

During the design of intelligent manufacturing cell, there was very important to conserve two basic subsystems as at the flexible manufacturing cell. Designed intelligent manufacturing cell also saves five manufacturing phase [2].

III. Types and Shapes of Handling Parts at the Intelligent Manufacturing-Assembly Cell

Design shape of gripper active element is the first step for the design of jaws shapes. Design of gripper active elements is made through graphic methods, which accept shapes, dimensions of handling element, necessary kinematics of jaws movement by the grip. These methods must accept touch points at the active parts of gripper jaws. On the (Fig.2 and Fig.3) are parts for production and parts for assembly at the intelligent manufacturing - assembly cell.

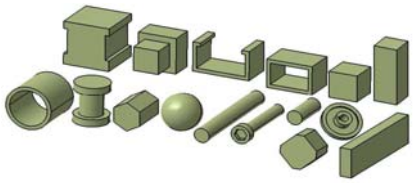

Fig.2 Parts for production

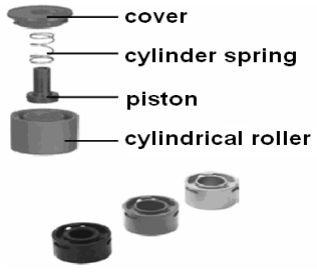

Fig.3 Parts for assembly

Main parameters for selection of grip method at the intelligent manufacturing cell:

- object characteristic of handling: shapes, dimensions, weight,
- object attribute: stiffness, shape, surface condition,
- places for grip: shape, centre distance, attribute of main places,
- handling requirements,

Shape design of gripper elements is dependent on shape, blanks, dimensions parts and cooperation with devices. Gripper jaws will be designed in two basic effectuates and will to handle with selected types and form of blanks and parts (Fig.4) [6].

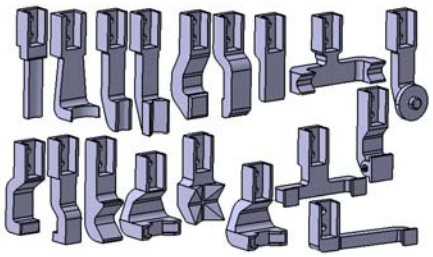

Fig.4 Gripper jaws

IV. Grippers Design in the Intelligent Cell

At this intelligent cell eight types of gripper jaws are situated. By this exchange are used grippers of types MHZ2. Blanks, parts, tools, fixtures can to be of handling subjects. These elements are as working objects. Elements of handling are physical entity of different forms, from different materials with different complexity. These elements have exact parameters as dimensions, weight. Different jaws of grippers will to handle with these parts at the intelligent manufacturing-assembly cell. At the “Fig.5” and “Fig.6” is AHC- unit for automated grippers change with grippers [5].

Fig.5 AHC-unit for automated gripper change

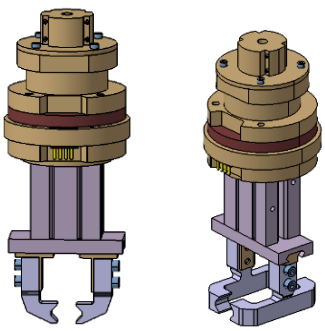

Fig.6 AHC - unit for automated gripper change with grippers

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V. Intelligent Manufacturing - Assembly Cell

Requirements for proper operation of intelligent manufacturing cell:

- gripper change on the basis of the working requirements,
- grippers of different jaws for handling [7].

Intelligent manufacturing-assembly cell workplace is 1000x800 mm. Buffers with grippers will be situated at the workplace of cartesian robot (Fig.7).

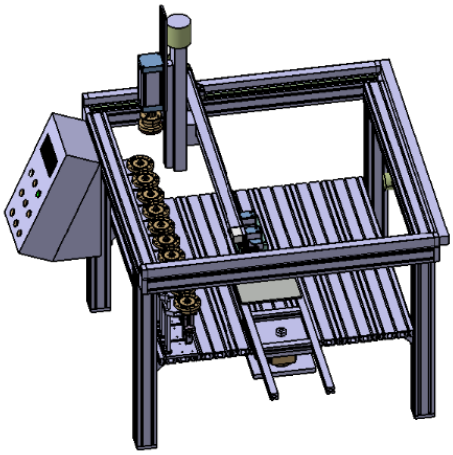

Fig.7 Intelligent manufacturing-assembly cell

VI. Sensorial Equipment Design of Automated Grippers Changing

Sequential diagram is used for writing methodology at the intelligent cell. This methodology is a good way how to analyze communication between single devices, which are placed in the workplace of the cell. For analysis of grippers are at the storage used inductive sensors with type **SIEN – M8NB-PO-K-L**.

For identification of single gripper types following to their shapes, was designed identification system, for which is using colour sensing sensors. This application is using two sensors with type **SOEC-RT**. Sensor placement is at the "Fig 8".

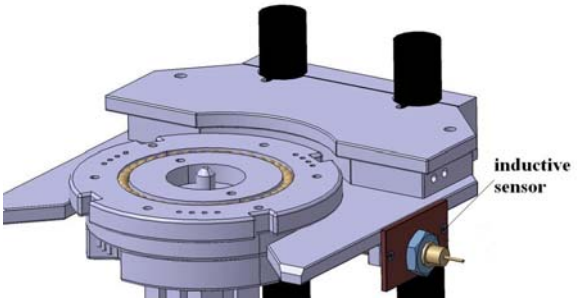

Fig.8 Design of inductive sensor at the gripper buffers

VI. Conclusion

During the design process of intelligent manufacturing cell, and during the design process of automated tool changing system, a sequential diagram methodology was used.

This methodology was chosen to describe communication of all devices during the manufacturing and also assembling process. Sensor equipment was selected following information, about the communication and signal transmission [4].

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VEGA 1/0206/09 Intelligent assembly cell

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