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# MOTION CAPTURING CONTROL FOR PARALLEL KINEMATICS ROBOT

**J. Augste, T. Novotný** *

**Abstract:** *This paper deals with using motion capturing technology for control of parallel kinematic robot. As a motion capturing system is used Microsoft Kinect device. Filtering and recognizing algorithms are applied to the output data from this device to capture inaccuracies and gestures that are used for position control. This evaluation system uses cluster computing device connected to the machine. The possibilities to communicate with the machine control unit and to use more tracking devices are discussed.*

**Keywords:** ***Motion capturing, parallel kinematics, programmable logic controller***

## 1. Introduction

Nowadays the remotely controlled devices are still frequently used. However the control devices (for example joystick) in many complex applications such as robotic hand control in hazardous environment are very inappropriate. One of the greatest reasons is a significant difference in kinematic structure of controlled and control devices.

Very intuitive option to scan the motion is use of a camera system and image processing. And these two things are implemented in one device Microsoft Kinect. Thanks to its low acquisition cost and its comfort programming interface (SDK) the Microsoft Kinect is the most advantageous choice for experiment realization. The Microsoft Kinect was used to control the parallel kinematics delta robot. This article deals with possibilities of communication between these two devices then it describes its flaws and the principle of robot control system reaction on operator gesture performance.

### 2.1. Background

The motion capturing technology (tracking of humanoid structure) is very well established. However the data processing and output reaction is not so stable. Because of the gesture recognition initiation and termination as well as unwanted motion recognition is really difficult to ensure.

There are two essential events in motion capturing technology. The first one is poses and the other one is gestures. The experiment requires a combination of both related to a time variable. The time utilization allows creating a system whose feedback is fast and stable. The motion processing device must reduce incoming commands quantity to a robot control system to a minimum level in order to not burden the computational power.

## 3. Materials and Methods

CNC controlling of robot with parallel kinematics is secured by programmable logic controller from Beckhoff. It allows the rotation calculation of each electric asynchronous motor using inverse kinematics. Input and output signals of the PLC are done via TCP / IP using the programming language C #. Class library reference TwinCAT.Ads.dll. NET contains all the necessary procedures and functions controlling the robot. The second used library is Microsoft.Kinect.dll that includes communication with the video output from the camera, image processing and motion evaluation.

* Ing. Jan Augste, Ing. Tomáš Novotný, ING-PAED IGIP: Institute of Production Machines, Systems and Robotics, Faculty of Mechanical Engineering, Brno University of Technology, Technická 2896/2; 616 69, Brno; CZ, emails: y101686@stud.fme.vutbr.cz, novotny.t@fme.vutbr.cz

Two approaches using the kinematic motion capturing control were created.

The first one is the direct control of the robot. The controlling session is started by operator pose - left hand over head. By moving the right hand the robot is guided to a specific position. The algorithms are used to filter unwanted movements such as shaking, so that the result has been a continuous movement. The procedure is performed using the TCP / IP communication.

In the second case the trajectory is entered first - after making the appropriate gestures of the operator. Then the trajectory is processed by inverse kinematics and sent to the robot that performs it.

*Fig. 1: Complexion of the design system*

## 4. Results

Both designed approaches differ in several parameters. One of them is an occasion for a specific application in industry.

The first solution is orientated on control in hazardous environment. Its disadvantage is quite big load on a communication which results in long system reaction on non-linear changes.

The second solution is very perspective for a robot programming. The great disadvantage is in absence of feedback, however there could be haptic feedback or simulation established in the future.

## 5. Conclusion

Although the motion capturing technology is known for a long time and intensively used in game and movie industry, its utilization in the field of automatic control and programming is not currently widespread.

This text deals with the two possibilities of motion capturing control for parallel kinematics robots. This ways has different utilization so their advantages and disadvantages are incomparable.

It is promised in next version of TwinCAT to enable real-time control using C++ so the next step of the research is to create a real-time control.

## References

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