

UNIVERSAL GRAPHICAL TOOL SUPPORTING THE IMPORT AND VISUALIZATION OF CONTOUR DATA

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Today's development on the market of automation requires a different approach in programming of motion applications especially in small-scale companies. Handling tasks, material processing or robotic applications requires tools for importing path information from CAD Systems and automatically generation of NC programs.

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1. INTRODUCTION

The concept of the virtual product goes beyond the structure, design and feature definition. It includes also the functional simulation of the virtual product in the appropriate working environment as part of the full product model. This enables the implementation of the following three main principles of the Virtual Engineering (VE) [1]:

- **Model and Simulate**, which means to simulate activities „virtually in the computer“;
- **Predict and Evaluate**, which means to determine what would happen if the activities were actually carried out;
- **Make Improvements**, before the actual manufacturing is done.

The company Systec, Germany (www.systec.de) implements the concept of “the virtual product” [2] and offers pre-engineered “custom-tailored” solutions (Drive Sets, Fig. 1, 2) according to the individual clients needs.



Fig. 1 Models of the *DriveSets*-family instances (a), (b), (c)

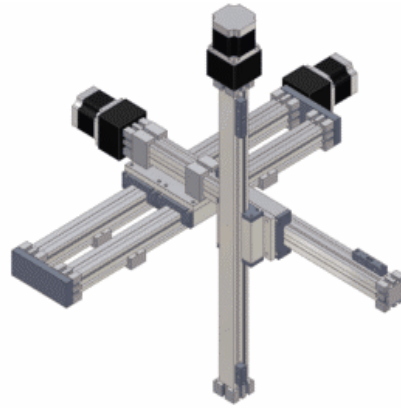


Fig. 2 The DriveSet as a modular technical system

Although the DriveSets are easy to program with a high-level programming language, many customers (especially from small companies) have difficulties programming typical automation tasks. Therefore a further step in developing this virtual product is needed – the automatic or semi-automatic generation of control programs for these devices, based on customer data, combined with simulation of the movements in the working area for test purposes.

Typical application of DriveSets include movement on a predefined contour, generated in diverse CAD Systems (gluing, spray operation, etc.).

The goal of our current research is to create an informational environment supporting the industrial applications of DriveSets, which includes the straightforward implementation of the control software based on software templates, actual CAD data and technological plant configuration. To be conforming to the principals of VE we provide simulation of the generated control program in a Virtual Reality environment using state-of-the-art VR player.

2. CASE STUDY

MotionContour is a universal graphical tool (Fig. 3) running on Windows 32 systems to read contour information from different sources, transforms the contours in various ways, automatically generate the NC program and simulate the program execution in Virtual Reality environment. In this way it acts in the same time as a user interface to run a DriveSet and as a functionally correct virtual model of the DriveSet. The DriveSet can be represented as a Cartesian robot with prismatic joints and up to six degrees of freedom [5]. The control system allows operation in Point-To-Point (PTP) and Continuous-Path (CP) Control Mode.

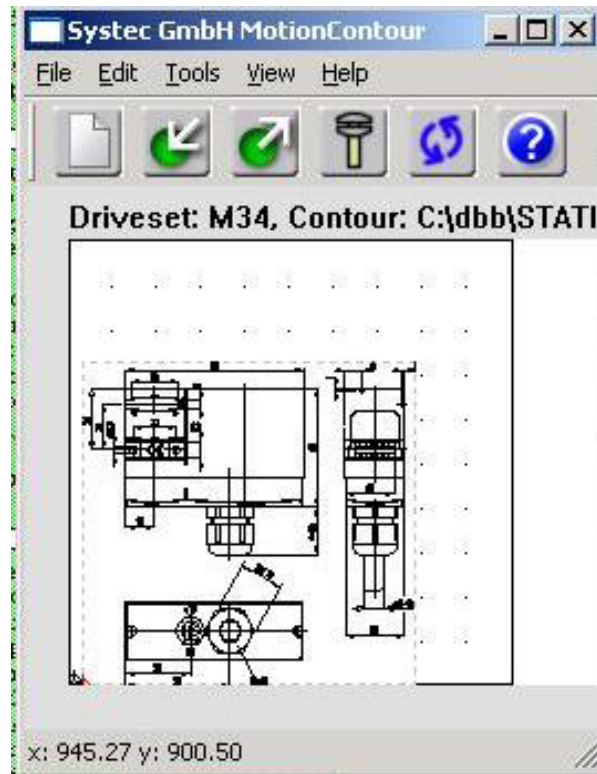


Fig. 3 MotionContour Application

MotionContour transforms the contour information appropriate to the kinematics of the DriveSet instance and supports up to six degrees of freedom, e.g. Cartesian coordinates are transformed to polar coordinates or it calculates transformations for parallel kinematics.

Online and offline operation of the motion system is supported. For offline operation commands and data structures for DriveSet's controller are generated (Fig. 4).

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Sub konturl(scale as long)
Vorspann()
Penup()
amove(scale*100, scale*110)
amove(scale*112, scale*110)
Pendown()
amove(scale*500, scale*120)
Penup()
amove(scale*500, scale*110)
amove(scale*512, scale*110)
Nachspann()
End sub

```

Fig. 4 Automatically generated Point-to-Point Mode control program

For test purposes the control program execution can be simulated in VR environment solving the reverse kinematics problem for the position of the end effector in both operational Modes. The connection with the embedded VR player is established via the External Authoring Interface (EAI).

In the case of online operation MotionContour directly runs the system. The DriveSet's status information (like error messages, status of inputs and outputs) is then presented to the user of MotionContour because it is in this case the main user interface.

3. CONCLUSIONS

Current research results address a menu-based system for import and visualization of contour data. A control program for Point-To-Point or Continuous Path Mode, derived from the contour data, is automatically generated. The system includes also a testing module for simulation and visualization of the robot movements in space, based on reverse kinematics' computation.

The user interface is adaptable to best fit for the different motion applications. It can read contours from CAD generated data, from manual input or input accomplished by teach-in. The user can graphically modify the contour in a limited way, e.g. smooth all points to a curve or fill in missing pieces. It knows the necessary characteristics of the motion system, i.e. dimensions, speed, acceleration to prevent exceeding their limits and realistically model the execution of the program in the test mode.

4. REFERENCES

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