Nanopositioning machines need a fast visualization and a modern control

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1 Introduction

Nanopositioning and nanomeasuring machines (NPM) serve for the positioning, measurement and treatment of objects with nanometer precision. Fields of application are, e.g., microelectronics, micromechanics, molecular biology and genetic engineering. In a Sonderforschungsbereich (special research project) at the Technische Universität Ilmenau (TUI) under the guidance of Prof. Jäger the scientific-technical basics for the design and for the implementation of NPM shall be developed. Fig. 1 shows a NPM, developed at the TUI, that possesses the following parameters:
positioning range: 25 mm x 25 mm x 5mm
resolution: 1,24 nm
positioning uncertainty: < 10nm
Since resolutions in nanometer range cannot be perceived by the human eye, NPM require an efficient, fast 3D visualization, e.g., to the operator's guidance. Moreover it must be possible to show the measurement results while measuring or treatment. Measuring and treatments in the field of nanometer require constant climatic conditions, so that only the real time components of the control may exist directly at the NPM. The proper user interface must or can be installed in another room, in another building or even for test and diagnosis purposes in another country somewhere in the world. A requirement for such remote controls is an efficient, fast visualization.
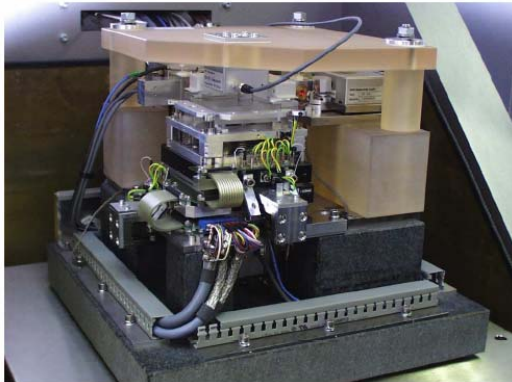

Figure 1: Nanopositioning machine

2 Visualization of measuring data and machine condition using OpenGL

Fast 3D graphics can be generated with the help of the system independent graphic software OpenGL. OpenGL enables to provide realistic three-dimensional pictures. Fig. 2 shows the representation of a measuring object which was programmed for the NPM with C# and OpenGL.
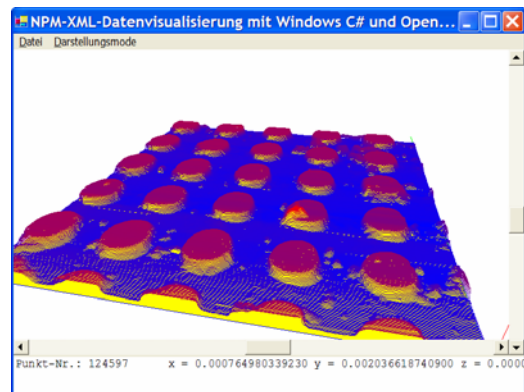

Figure 2: Visualization with C# and OpenGL

With the mouse and further control elements the navigation in space is possible. You can click on single measuring points and the coordinates of the points will be displayed with nanometer resolution within the text window. Advantages of the graphic libraries of OpenGL are, e.g., platform independency, hardware support and the integration into several programming languages (e.g., C++ and C#). The file format for data is based on XML.

3 Teleservice for NPM

With the .NET technologies, Microsoft provides a multitude of tools for the teleservice, which simplify the development of distributed applications strongly.
The principles of .NET remoting and the use of .NET web services are examined. Remoting enables a fast connection over a special channel, but it requires the .NET framework on both the server and the client. If the client shall be independent of the platform, the application of web services is recommended.
Besides different principles of providing functions over a computer network, questions of data security and user administration need to be discussed as well, of course.