9:00 a.m.	Ch. Recknagel, H. Rothe (DE-Hamburg)

Automation of Basic Measurement Tasks of the Nanometer Coordinate Measuring Machine
The Nanometer-Coordinate-Measuring-Machine (NCMM) is developed for comparatively fast large area scans with high resolution. The system combines a metrological atomic force microscope (AFM) with a precise positioning system (NMM-1). The sample is moved under the probe system via the positioning system achieving a scan range of 25 x 25 x 5 mm^3 with a resolution of 0.1 nm. The automation of basic measurement tasks is critical for commercial use in nanometrology. A concept for automated measurements using a-priori-knowledge is introduced. Through the use of a-priori-knowledge measurement plans can be created offline. Dimensional markup language (DML) is used as a transfer and target format for a-priori-knowledge, measurement plans and measurement data. Using image registration in combination with an optical microscope regions of interest and markers can be identified automatically. After the optical measurement of the part coordinate system the measurement of the measurement elements with the AFM sensor of the NCMM is done. In contrast to commercial AFMs the NCMM has the possibility to do measure in non-raster-patterns and to do real coordinate measurements. In two case studies the use of the automated measurement is shown. In the first case studies the calibration of the device using VDI guideline 2656 is automated. In a second case study the characterization of a commercial nanofiltration membrane is done for the purpose of quality savety.

9:20 a.m.	J. Reger, A. Amthor, B. Schmidt (DE-Ilmenau)

FIR-Filter Design for Derivative Estimation in a Nanopositioning System
The paper is concerned with the real-time estimation of time derivatives with respect to signals subject to measurement noise. To this end, an algebraic counterpart of a weighted least squares algorithm is reformulated in order to find a tunable balance between proper noise attenuation and acceptable estimation delay. The estimator derived in this paper has the structure of an FIR filter whose coefficients may be calculated in an offline manner. Hence, the advocated model-free approach is well-apt for the derivative estimation under real-time conditions. The serviceability of the approach is demonstrated on a nanopositioning system where the carriage velocity needs to be reconstructed out of the noisy position signal.

9:40 a.m.	K. Treichel, K. Wulff, J. Reger, St. Amthor (DE-Ilmenau)

Modelling and Identification of a High-Precision Planar Positioning System
In order to meet the increasing requirements in high performance and high dimension accuracy for positioning systems, there has been active research on hovering, high-precision planar positioning systems in the past few years. While latest technology provides precise

positioning capabilities down to the Nanometer scale, further improvements in high-precision dynamic positioning will only be possible by applying modern nonlinear control methods. This contribution constitutes the first step towards this ambitious goal by providing a detailed mathematical model of Tetra's state-of-the-art positioning system "PPS200". The "PPS200" positioning system consists of two main elements. An aerostatic guided slider carrying the load to be positioned and a stator plate with embedded coils. The slider is floating on air-bearings above the stator plate providing nearly frictionless motion. Permanent magnets are mounted at the bottom of the slider such that the magnetic field induced by the current through the coils of the stator plate results in a force (Lorentz' law) that is used as principle of propulsion. Based on physical models of these main components and their dynamical interaction we develop a thorough mathematical model of the positioning system. We identify the unknown parameters and characteristics of the physical components using data of the provided test rig. The resulting model is finally verified by measurements taken from the experimental setup.

10:00 a.m.	V. Polyakovski, S. Karpovich (BY-Minsk)

Control Algorithms of Planar Multicoordinate Positioning Systems
Control algorithms of planar multicoordinate positioning systems CONTROL OF MECHATRONIC SYSTEMS Introduction In computer-aided equipment of micro- and nanoelectronics items production multicoordinate systems of positioning configured out of several planar positioners placed on one stator which are meant for realization of technological and transport environment of production are rather perspective. In such systems planar positioners should provide required joint motion on the fixed trajectories considering possible geometrical collisions. The basic problem in control algorithms of multicoordinate positioning systems is in tracing the trajectories of motion of each of the positioners. It is desirable that it is optimum in speed, in fixed coordinate set of contact points with fixed pairwise combination of their bypass. Control algorithms Complex tracing algorithms to solve the task of multicoordinate positioning system’s control are described in the paper. Based on the proposed comprehensive approach to tracing trajectories of planar positioners movements, it has been proposed a trajectories tracing algorithm for the control system of a printed-circuit boards tester when in use. According to this algorithm on each subsequent movement of positioners from point to point it's being generated the law of movements in analytical or numerical type which is accepted for realization or rejected depending on the results of calculation based on the algorithm of analysis and collisions prevention. Consequently after successful performance of the tracing realized by the proposed algorithm, trajectories of planar positioners movements are being generated as well as movement laws optimum in speed, which realization in the planar positioner control systems excludes collisions probability.

10:20 – 10:40 Coffee break