Drift-insensitive distributed calibration of probe microscope scanner in nanometer range: Real mode

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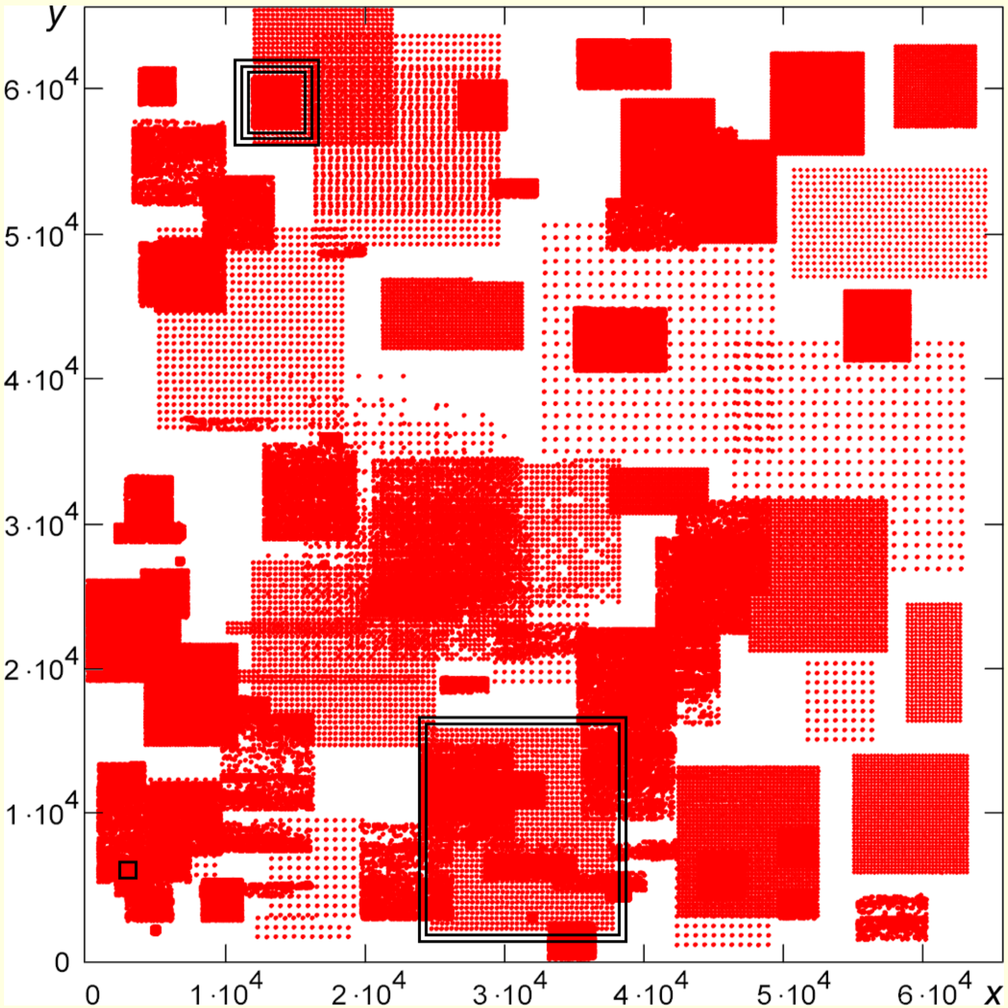
Key ideas of distributed calibration

The method of distributed calibration of a probe microscope scanner consists in a search for a net of local calibration coefficients (LCCs) in the process of automatic measurement of a standard surface, whereby each point of the movement space of the scanner can be defined by a unique set of scale factors. To eliminate the negative influence of noises, thermal drifts and creeps upon the distributed calibration results, the methods of feature-oriented scanning (FOS), feature-oriented positioning (FOP), counter-scanned images (CSIs) are used

Positioning the real mode in the context of the study

The article completes the series of three articles dedicated to the FOS-based distributed calibration. The real mode being the subject of the present investigation implies that the distributed calibration of the scanner is performed by graphite crystal lattice in real time. The real mode permits to acquire the calibration database (CDB) that completely characterizes the piezoscanner of the scanning probe microscope in use. The developed method of distributed calibration is one more component of the feature-oriented scanning methodology

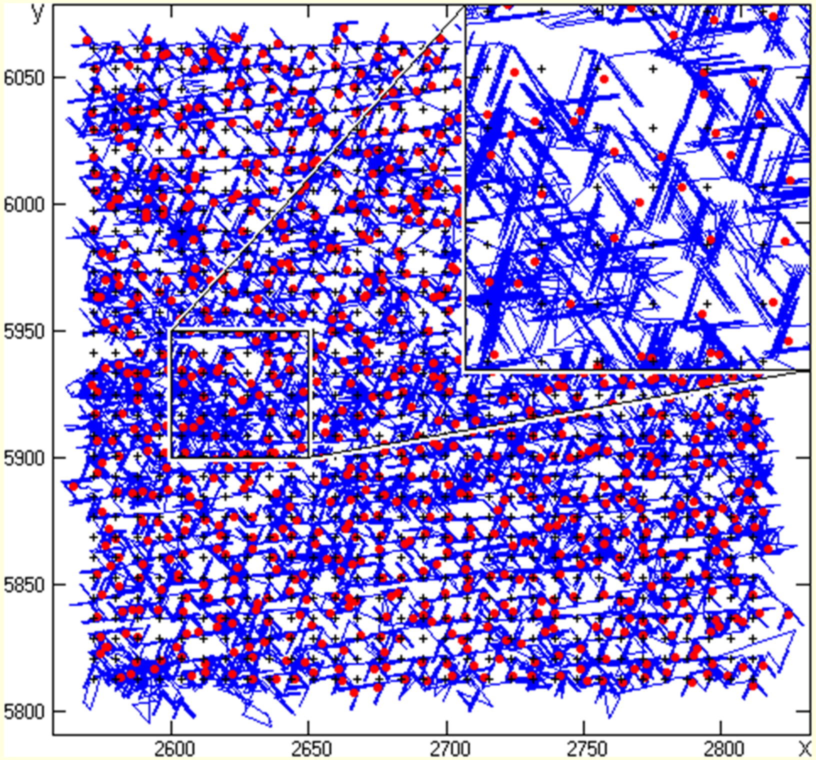
Areas covered by distributed calibrations



The whole scanner field is approximately equal to 2×2 µm

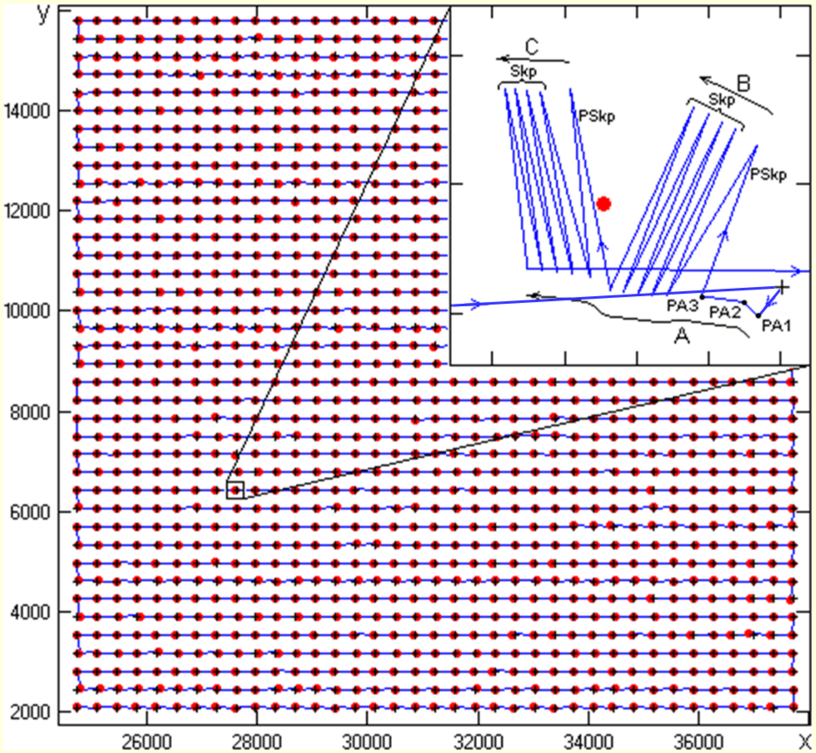
Distributed calibration

Area 73 × 73 Å (31 × 32 nodes), step 2.44 Å



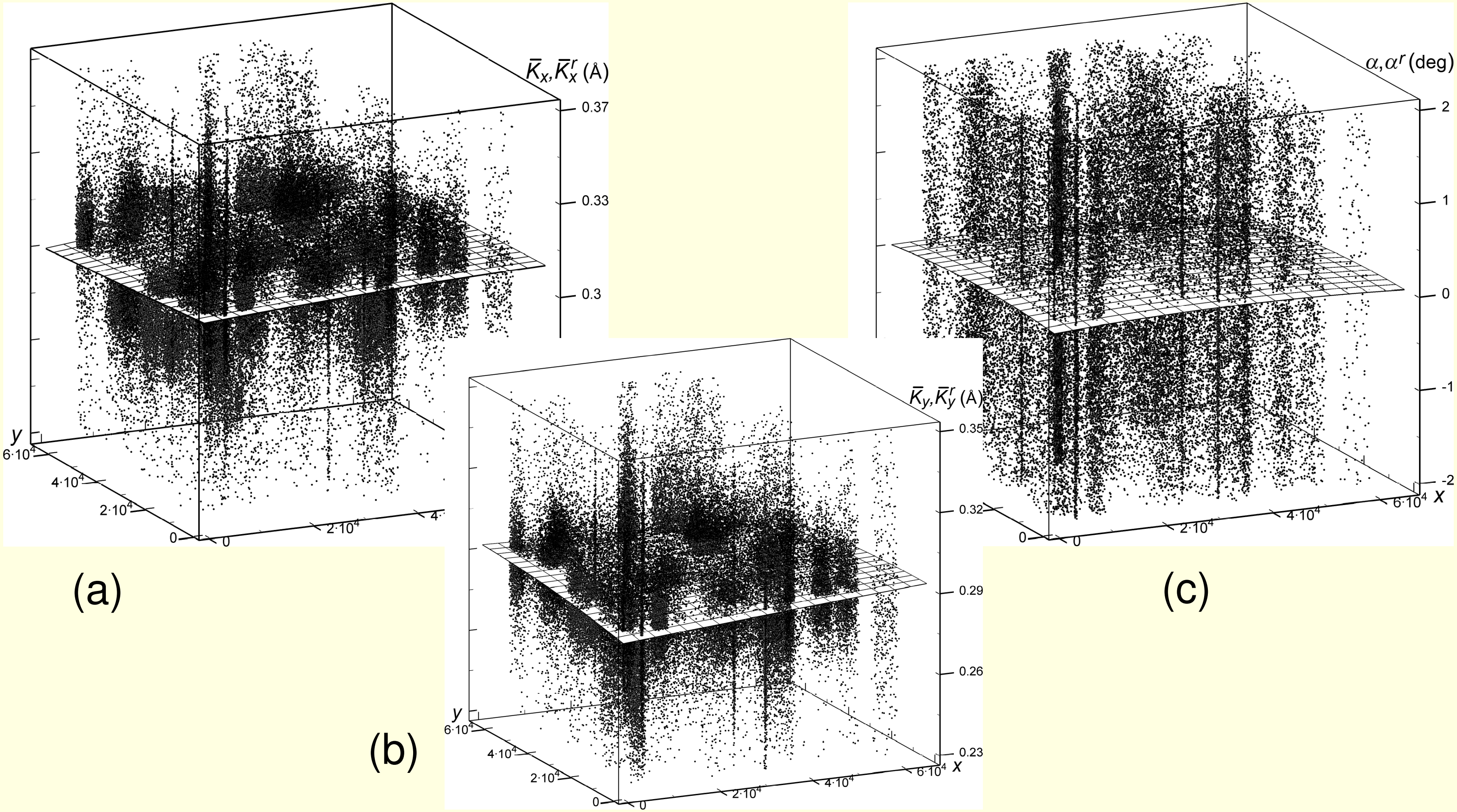
992 LCSs

Area 396 × 402 nm (37 × 39 nodes), step 11 nm



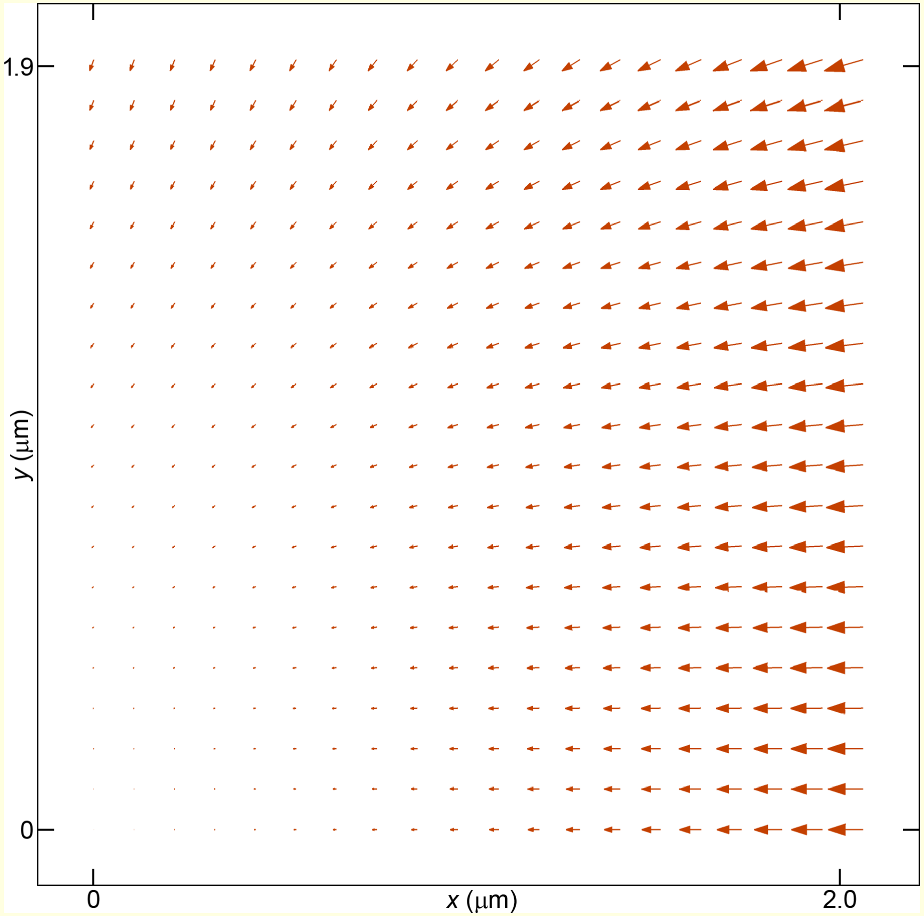
1443 LCSs

Calibration database



The searched for regression surfaces drawn through LCCs (a) K_x, (b) K_y, and (c) local nonorthogonality α accumulated in calibration database

Static nonlinear distortions of the piezoscanner in the lateral plane



The arrows show the value and direction of the distortion

Research summary

- Operability of the distributed calibration method built on the base of feature-oriented approach has been experimentally confirmed
- Feasibility of accurate calibration of the probe microscope scanner by a crystal lattice of highly oriented pyrolytic graphite at room temperature has been proved
- Insusceptibility of calibration results to thermal drift of the head and to creep of piezomanipulators has been proved
- Reduction of noises and instabilities by means of repeated measurements unlimited by number has been demonstrated

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