Atom Tracking Module

NANONIS SPMCS-AT4

The SPMCS-AT4 module adds atom tracking capability to the Nanonis Base Package. It is designed to track topographical features dynamically and can therefore measure and compensate for thermal drift and sample tilt. This module is of particular interest when the tip position has to follow a local maximum (e.g. an atom or molecule) between point-spectroscopy or when scanning a small scan area where drift is highly noticeable. The AtomTracking module is tightly integrated with the Nanonis software thus simplifying routine operation with Spectroscopy or Z-Controller module for instance and makes it easy for the user to define customized experiments together with the Nanonis programming interface (optional). Additionally, the Quick Operation Procedures automatically calculate drift velocity and sample tilt in both x and y directions.

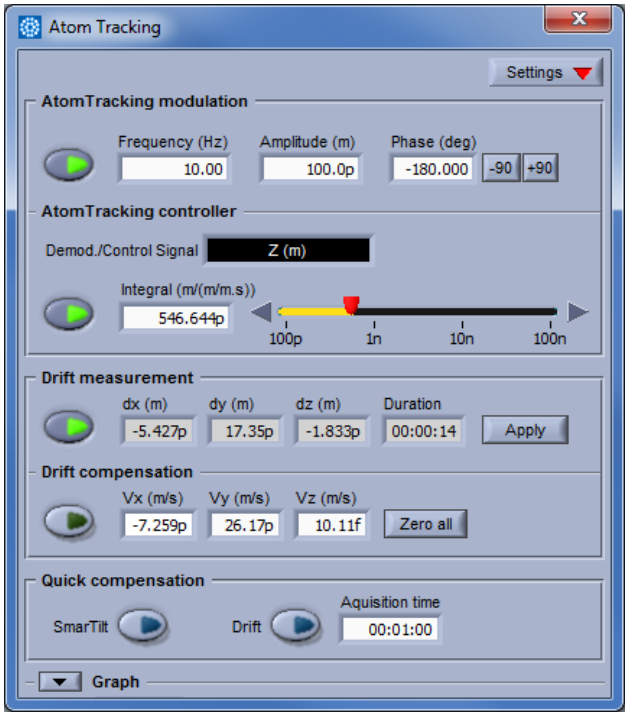

Fig.1: Screen shot of the AtomTracking module. The tip is drawn in circle with a given Frequency and Amplitude (AtomTracking Modulation), while the Integral-controller regulates the tip x/y position (AtomTracking Controller). It includes Quick Operation Procedures for automatic drift and tilt correction.

Principle: by applying a sinusoidal modulation to the x- and y-coordinate, the tip defines a rotational plane. The z-position of the tip is then demodulated with two lock-in detectors referenced by the modulation, leading to the slope along x and y directions, that is $\partial z/\partial x$ and $\partial z/\partial y$. These signals are then used as the input for the I-controller feedback loop, which adjust the tip x/y position in order to minimize the slopes, i.e. the tilt of the plane in which the tip rotates. In this way, the tip x/y position is locked on top of a local extremum which can be an atom, island, pit, etc....

Benefits: the original motivation to develop AtomTracking was to ensure reproducibility when performing several spectroscopy curves on top of a single atom or molecule but in general it can be used for:

- Dynamic local extremum tracking
- Drift compensation (calculate thermal drift velocity)
- Local plane subtraction (remove sample tilt along x- and y- axis)

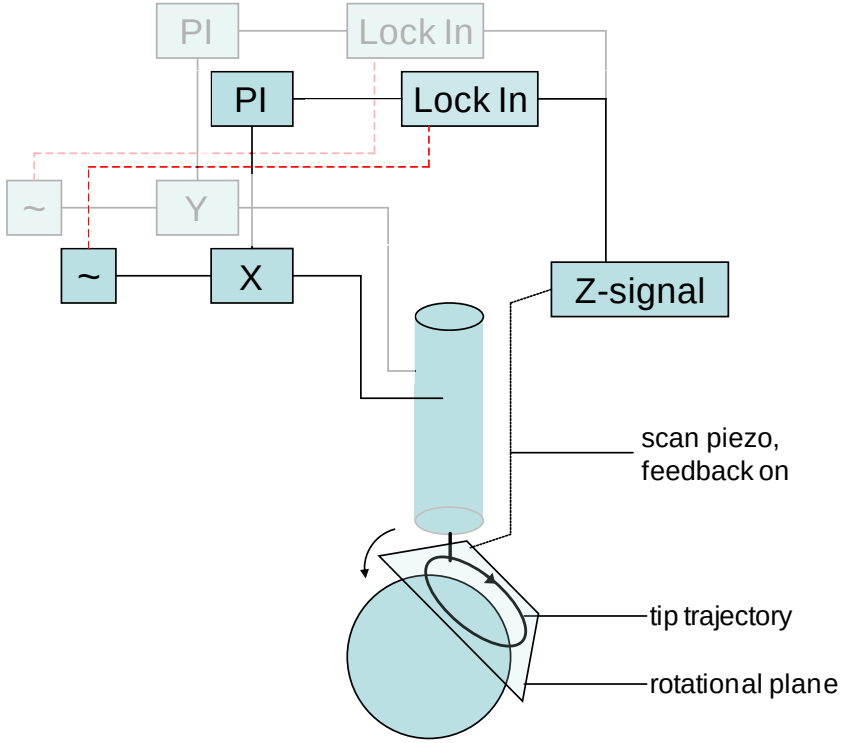

Fig. 2: Principle of the AtomTracking module. For clarity, the PI Loop for the z-feedback is not included in this drawing.

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