

عنوان مقاله:

Design of a Hybrid Control System for Atomic Force Microscope Using Adaptive Nonlinear Observer and Backstepping Controller

محل انتشار:

دومین کنگره بین المللی علوم و فناوری نانو (سال: 1387)

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خلاصه مقاله:

The atomic force microscope (AFM) or other wise called scanning force microscope (SFM) was invented in 1986 by Binnig, Quate and Gerber [1]. It has been operated in two modes. Open loop and closed loop. One of the major drawbacks of the open loop operation in AFM is chaotic behavior which causes errors in topographical information. In a closed loop operation, the cantilever deflection is maintained by a feedback controller at a set point while scanning the sample surface. The AFM systems suffer from creep, hysteresis, and limited bandwidth of operation, nonlinear dynamics and parameters uncertainties. For this purpose several feedback control strategies and force identification methods [2]-[6] have been developed in order to improve the AFM operation and reduce above mentioned errors. However, they provide limited vibration-dynamics compensation and usually suffer from design complexity. Furthermore most of these methods employ linear model for the system which is based on measured frequency response and curve-fitting. In this paper a hybrid nonlinear control scheme for an atomic force microscope is developed. For this reason a backstepping control algorithm is presented to achieve asymptotic cantilever tip tracking for bounded tip trajectories. In addition, for the purpose of force identification and variations of cantilever-tip parameter estimation, using adaptive input-output feedback linearization technique a nonlinear observer is designed. Simulation results obtained confirm the effectiveness and validity of the proposed hybrid controller.

کلمات کلیدی:

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