

A High Bandwidth Tapping Mode Atomic Force Microscope Controller based on Field Programmable Gate Array

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Abstract

Advanced microscopy technique has become an important research topic as people starts to pay more intention to the study of the structure and dynamics of biological molecules. Among all the other advance microscopy techniques, Atomic Force Microscopy (AFM) is unique in its capability of high resolution imaging of vital biological samples in aqueous solutions. However, conventional AFM isn't suitable to observing single-molecule biophysics due two reason: the low imaging framerate and the disturbance force between sample and AFM probe. This research topic focuses on optimizing the design of the digital control circuits in Atomic Force Microscope system referring to other the works that focus on increasing the bandwidth of AFM controller and lowering the disturbance force. When testing on a real AFM system, the proposed system is able to finish scanning a 256*256pixel image with scanning range of $1.5 \times 1.5 \mu\text{m}^2$ in 6 second.

Keywords: High Speed AFM, Tapping Mode AFM, PID controller, Amplitude Detector, FPGA.

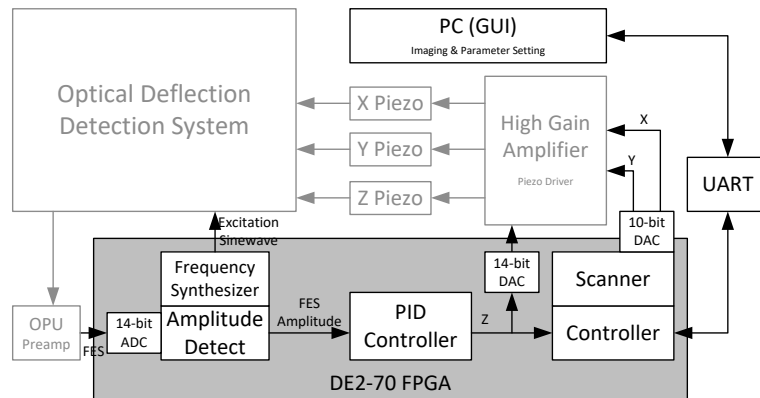


Fig. 1: System Structure of Proposed AFM Controller

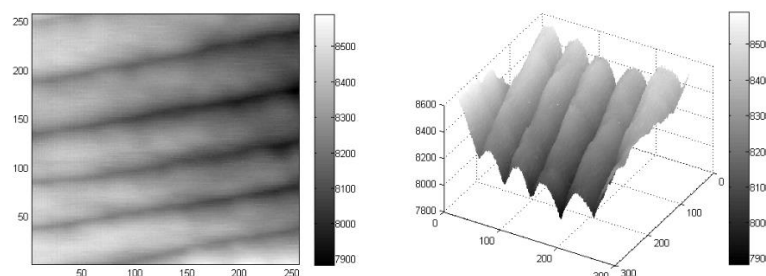


Fig. 2: Empty BD track scanned by proposed AFM Controller