

Digital Capacitance Sensor Provides Closed-Loop Piezo Positioning Control

21st century electronic manufacturing requires fast, precise positioning of miniature components. For many assembly lines, process control has moved from mm to micron, or even sub micron, accuracy. Keeping pace with the demand for greater precision requires piezoelectric positioning actuators and/or voice coil motors with closed-loop feedback control.

Challenge

Traditionally, analog feedback from capacitance sensors has enabled the closed-loop control of conventional positioning stages. Harnessing the extreme accuracies achievable with voice coil motors or piezoelectric stages, however, requires motion stage feedback from a digital position sensor. Compared to analog systems, digital closed-loop control offers more power efficiency with less noise, interference, and/or distortion.

Solution

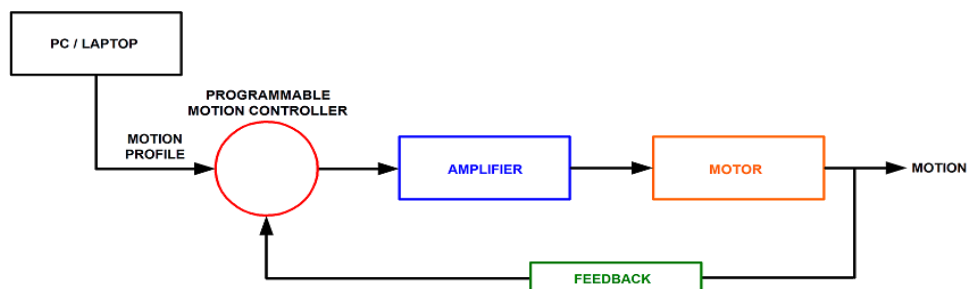
Recently developed digital capacitance sensor systems, now available from MTI Instruments, provide closed-loop feedback for precision positioning applications involving piezoelectric actuators or voice coil motors. These sensor systems comprise a digital capacitance probe and digital Accumeasure capacitance amplifier.

During operation, the probe measures piezo stage position in real time. [The Digital Accumeasure Amplifier](#) then sends the stage position to the programmable motion controller via Ethernet output.

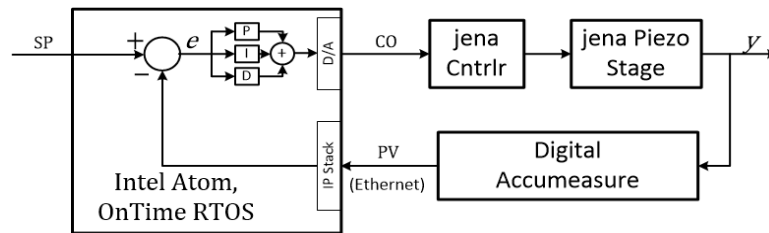
The motion controller compares these feedback signals to a command position set point, enabling the controller to adjust the piezo stage with sub micron precision. If a change in set point is commanded, or a process disturbance occurs, the controller performs calculations based on the changes, and returns a value that puts the motion stage exactly where it is commanded to be. Overall performance depends on how fast the controller responds in conjunction with all of the positioning components and the feedback sensor.

Benefits

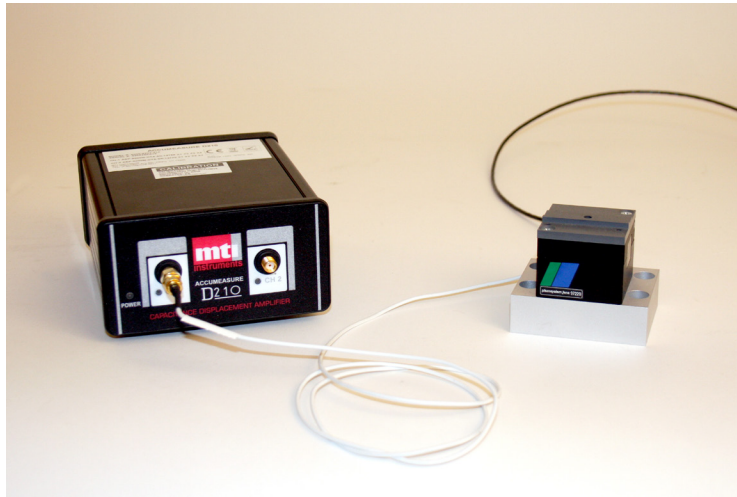
MTI's digital capacitance probes feature non-contact measurement for zero mechanical loading. MTI's Digital Accumeasure capacitance amplifier functions as an effective digital position control sensor. Because it provides Ethernet output, the Digital Accumeasure amplifier can be located far from the controller. Multiple probes can be networked with no signal degradation as long as the positions can be read within the controller's loop control cycle.



In this typical closed-loop setup, a high voltage amplifier drives the motor. For precision positioning applications, the motor may be a piezo electric stage or voice coil motor. The programmable motion controller uses a traditional PID loop.



Control loop test configuration features a piezo stage from Piezo System Jena, driven by a high voltage amplifier also from Piezo System Jena. The programmable motion controller is an Intel Atom CPU with real time operating system software. RTOS avoids the latency found in a typical Windows environment.



MTI digital capacitance amplifier with MTI ASP-500M-ILA capacitance probe, embedded in the Piezo System Jena PX-100 stage. The digital amplifier offers exceptional accuracy and linearity. Off-the-shelf control programs, moreover, make it easy to use and tune digital feedback.

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