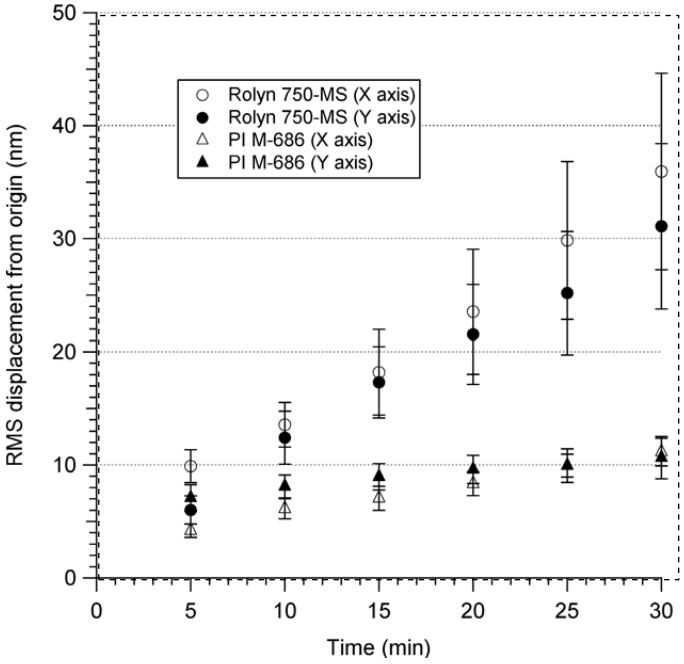
Position Stability in Linear Ultrasonic Motor-Driven Stages

Ultrasonic ceramic motors are based on the nanoscopic motion / friction between a ceramic tip and a ceramic friction bar. At rest, the motors automatically lock into a position. This inherent feature has recently aided research in optical trapping, ultra-high resolution microscopy and other bio-technology related applications. Stability data are shown below.

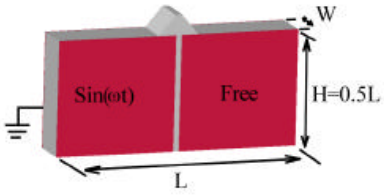
Keywords: stability, piezomotor, PZT, ultrasonic motor, standing-wave, piezoelectric actuator, linear motor, piezo, non-magnetic, piezoceramic, microscopy



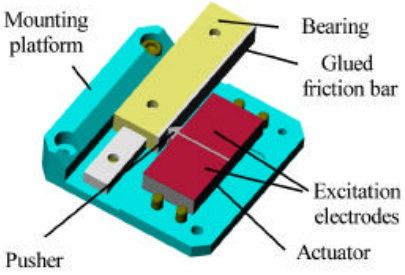
Drift performance of simple [spring-preloaded] screw-driven microscopy stage versus self-clamping piezomotor stage. RMS displacements (nm) from the origin of polystyrene beads affixed to the microscope sample coverslip, which was attached to a Physik Instrumente P-517 piezoelectric nanopositioning stage mounted on either a Rolyn 750-MS manual substage (circles, N = 8 measurements) or a Physik Instrumente M-686 PIline substage (triangles, N = 9 measurements). Both stages are of crossed-roller-bearing construction; the screw-driven Rolyn stage has no motors or encoders which might contribute to drift [leadscrew / nut / motor drives are significantly less stable than spring-preloaded manual micrometer drives]. Displacements were measured by back-focal plane detection (see Methods). Symbols represent mean ± standard error.

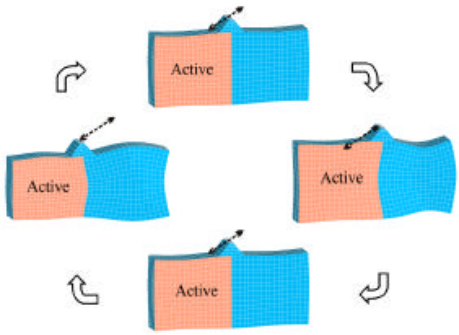
Excerpt from: Design Considerations for Micro- and Nanopositioning: Leveraging the Latest for Biophysical Applications, Current Pharmaceutical Biotechnology, 2009, 10, 515-521 by S.C. Jordan, and P.C. Anthony.
http://www.ncbi.nlm.nih.gov/pubmed/19689320

The M-686 XY ultrasonic piezo motor stage.



Piezoceramic ultrasonic motor stator (top) and basic design of piezo-actuator-driven translation stage.





FEM simulation of the two-dimensional standing extension wave in the piezoelectric plate.