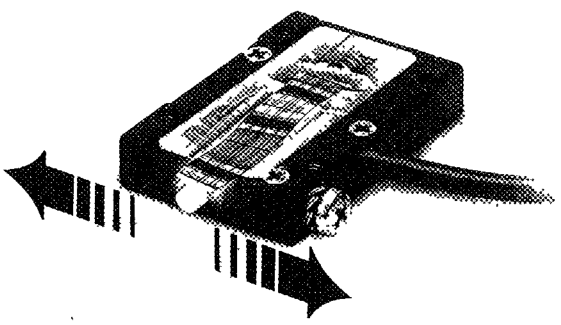
When Novel Motor Technology Faces Application Limitations

• Alan Feinstein[1] •

Over the past decade, the continued development of Ceramic Servo Motors has played an active role in achieving high levels of performance in motion systems. The ceramic servo motor technology has bridged a gap between resolution and speed that no other motor technology has been able to achieve. The technology has developed the ability to resolve motion below 1nm, yet run at velocities from 1µ/sec to more than 300mm/sec.

This technology has supported a multitude of industries (Semiconductor, Biomedical, Photonics, Metrology), in the ability to reduce machine size, increase throughput, and tighten tolerances for better part reliability. Ceramic servo motor technology provides the highest force per volume of occupied space, making it a very powerful motion control device.



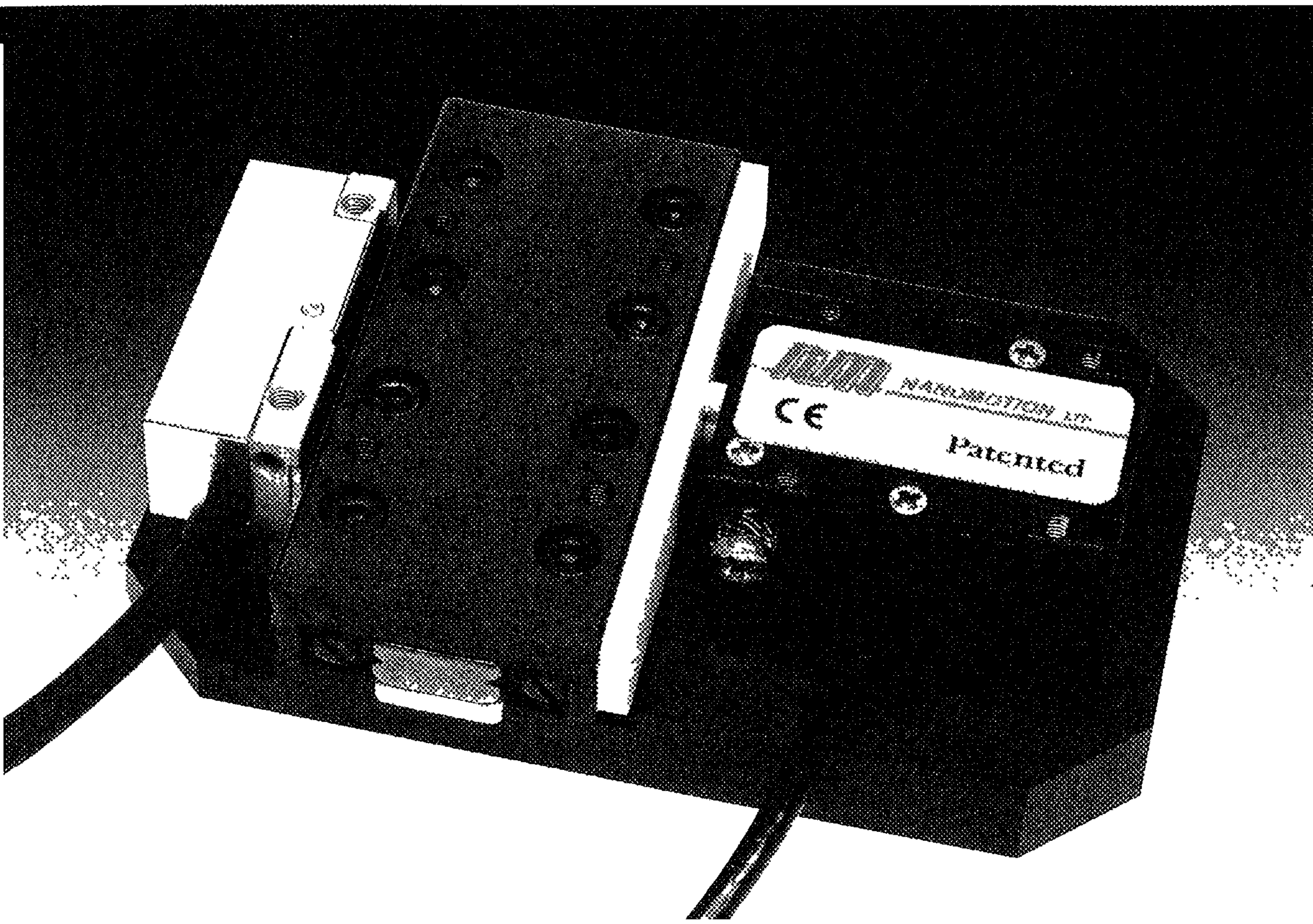
The motor technology, pioneered by Nanomotion provides exceptional motion control performance, while transmitting linear or rotary motion by preloading a piezoceramic element against a bearing structure.

The motor element is simultaneously excited in a longitudinal and transverse (bending) mode to create a micro-ellipse at the tip. When compressed against a linear or rotary stage, motion is generated.

While this technology has become well established in high performance motion systems, its general application deployment has been limited by the controllability, with respect to managing a non-linear voltage-to-velocity profile. The normal force, generated when the motor is preloaded against a bearing structure, creates a dead-zone in the range of ±1 volt from the servo controller

Until recently, this dead-zone has been managed by the use of custom servo algorithms that created a bi-directional offset The offset functions were limited to a select group of

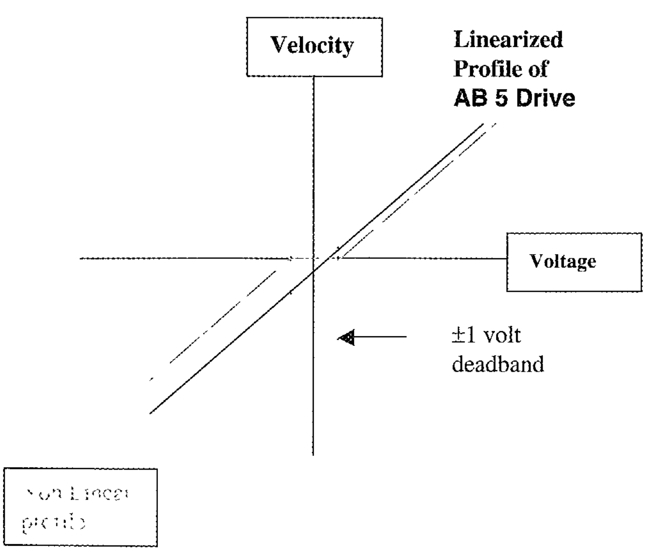
1 Nanomotion Inc



"high end" servo controls that required special care in set up and tuning. This is quite synonymous with "Torque Offset" command, while driving a vertically mounted linear stage with a lead/ball screw. Additional power is provided in the up direction to compensate by the additional force of gravity.

Recent developments within the motor amplifiers, that drive Nanomotion motors, have completely eliminated the need for offsets and custom algorithms. The latest version of amplifier "linearizes" the voltage to velocity profile, allowing for exceptional performance with any motion controller.

This amplifier (AB5) allows the user to turn off the static holding force, which created the deadband. This is achieved by allowing the ceramic motor to move in/out, perpendicular to the direction of travel. Once the holding friction is eliminated, the slightest output voltage from the controller will create motion.



The introduction of this technology allows a multitude of industries to benefit from the performance capability of ceramic servo motors, without having to change their control platforms. Even simple PLCs and other cost effective control cards are well suited to generating a high level of motion control performance.

Test results demonstrating a linear motion profile at low velocity with one count position error can be found in Nanomotion website, under technical publications.

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