

RoboMate™ (Pat. Pending) - represents a quantum leap in micro/nano-positioning evolution. The result, based on a totally new concept and design principle, is a precision desktop-size hybrid (combined rotational and linear) motorized nanopositioning system. The system is the first of its kind to allow the probe/tool to be precisely positioned at infinitely variable angles with respect to the target sample. Using DTI's Virtual Point™ technology the tip of the probe/tool (or lens) can remain fixed at a specific point whilst it's angle of approach with respect to the target sample can be varied continuously.

When re-inventing the wheel ...



... makes good sense !

RoboMate™ - Complete system including RoboMate angular/linear positioner, motorized XYZ platform, dual DSP-controllers/joysticks and Windows™ operating software (laptop PC and nanoliter injector shown not included)

Background

For over 100 years the basic design principle used in standard micropositioner and micromanipulator systems has remained relatively unchanged based on the traditional X,Y and X,Y,Z linear displacement configurations; whereby each axis of linear movement is fixed and perpendicular with respect to an orthogonal axis of linear movement. Whilst a number of technological advances have been made in micropositioner design; such improvements have generally focused on the mechanics and control systems to (for example) provide increased accuracy, better resolution, increased stability and reduced drift.



Fig. 1 - RoboMate System
(including motorized XYZ platform)

Despite these improvements it is often desirable during an experimental or manufacturing procedure to alter the angle of approach of a probe/tool with respect to the target sample. Although a number of micropositioner manufacturers have developed *ad hoc* adapters and devices, or have implemented mechanical design changes that permit move-

ment outside of the orthogonal planes (e.g. rotational movement and/or angular movement of a linear axis); such adaptation is generally cumbersome requiring the probe/tool to be removed from the target sample while the new position/angle is then pre-set by hand. Currently there is no device commercially available that allows simultaneous precise control over the angle of approach and linear movement of the probe/tool.

Solution

RoboMate is a state-of-the-art hybrid motorized nanopositioning system that is the first of its kind to allow the probe/tool to be precisely positioned at different angles with respect to the target sample. Using DTI's Virtual Point™ technology the tip of the probe/tool can be positioned extremely accurately to a fixed point on (or above) a target sample and remain fixed at that point whilst its angle of approach to the point can be continuously varied.

Design

The functional design of RoboMate incorporates two advanced proprietary piezoelectric motors and a linear stage based on a similar motor technology. The first rotary motor is mounted via a bracket to a heavy base plate or vibration-free table. The output shaft of the first motor is fixed to a rigid link, and the other end of the link is mounted directly to the second rotary motor. The rigid link has a right angle bend such that the axis of rotation of the shaft of the first rotary motor is orthogonal to the axis of rotation of the shaft of the second rotary motor. A third motor (the linear stage) is secured by means of an additional rigid link to the output shaft the second rotary motor. The linear stage drives the probe/tool in both forward and reverse directions. Control over angular and linear movement of RoboMate is then achieved using either the joystick or Windows application software (robomate.exe). An (optional) optical encoder integrated into the linear drive motor allows precise software control of the position, direction and speed of the linear movement.

Virtual Point™ Technology

A Virtual Point is formed where the axis of rotation of the first and second rotary motors and the longitudinal axis of the probe/tool intersect (Fig. 2). When the tip of the probe/tool is positioned at the Virtual Point, changes in the angle of the probe/tool will not affect the position of the tip of the probe, which will remain at the Virtual Point.

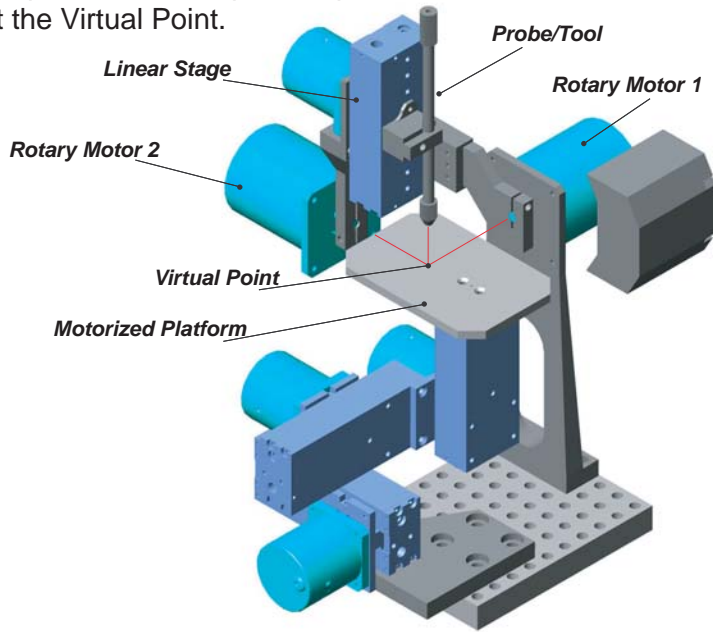


Fig. 2 - Illustration of the functional elements of RoboMate
Dimensions of complete system shown
300(h) x 250(w) x 200(d) mm

Operation

The RoboMate joystick controls both the direction and the velocity of movement. The target sample under study is placed on the (optional) motorized X,Y,Z platform (Fig. 3), which is then positioned within the working angular coordinates of RoboMate using a second joystick. Once in position the probe/tool of RoboMate can be brought to the target. A combination of movement of the motorized platform and RoboMate enables an unlimited number of positions of the probe/tool with respect to the target sample.



Fig. 3 - RoboMate Motorized XYZ Platform

Range of Movement

The angular range of movements of RoboMate is from -90 degrees to +70 degrees for each of the rotary motors. The moving platform has a range of movements of 50 mm x 50 mm x 50 mm. This range determines the sample volume accessible by a probe/tool placed on the platform.

Digital Signal Processor Control

The core of the system design is an advanced piezoelectric rotary motor driven by a digital signal processor (DSP) based controller. When the motor is de-energized, it operates as a steadfast position holder (brake) with almost undetectable backlash and drift. An additional key component of the system is the NanoDirect™ series controller designed entirely on a proprietary DSP platform, which enables a wide dynamic range, high measurement accuracy and unparalleled performance.

Software control over the movement of RoboMate can also be achieved using a Windows 2000/XP based GUI.



Fig. 4 - RoboMate System with Optional Nanoliter Injector

Technical data

RoboMate	
Rotary motor angular range (from vertical)	-90° to +70°
Minimum angular step	0.00055°
Angular rate of rotation	0.006°/s - 90°/s
Range of linear motor movement	50 mm
Minimum linear step	0.1 µm
Range of linear velocity	1 µm/s to 25 mm/s
Step size of linear movement (in step mode)	0.01-1.0 mm
Max. Load	0.5 kg
Push/Pull Force of the linear piezoelectric motor	20 N
Rotary Axis Drift at 20°C	Less than 0.0003°/hour
Linear Axis Drift at 20° C	Less than 2 nm/hour
Weight	2.85 kg
Dimensions (mm)	300(h) x 160(w) x 180(d)
Supply Voltage	12 V
Nominal Power Consumption	3 W

Motorized XYZ platform	
Range of movement	50 x 50 x 50 mm
Minimum linear step	0.1 µm
Range of velocity	1 µm/s - 25 mm/s
Max. Load	5 kg (X,Y); 2 kg (Z)
Max. Push/Pull Force	20 N (for each Axis)
Long Term Stability Drift at 20°C	Less than 2 nm/hour
Weight XYZ platform	1.3 kg
Dimensions (mm)	110-160(h) x 160(w) x 120(d)
Supply Voltage	12 V
Nominal Power Consumption	2 W

Ordering Information

Part Number	Description
B14-3101	RoboMate Angular/Linear Positioning System*
B14-3102	RoboMate Angular/Linear Positioning System* includes optical encoder on linear drive
B14-3201	Motorized XYZ Platform for RoboMate*
Accessories	Contact DTI for full list of accessories

*includes: controller, Joystick, 110/240 AC to 12 V DC adapter, Windows2000/XP application software, USB cable

Applications

The unique positioning capabilities of RoboMate and its miniature size means that it has important applications in many fields of science, engineering, medicine and manufacturing, where all too often the traditional methods of positioning tools rely upon standard X, Y, Z micropositioner systems. RoboMate overcomes the inherent drawbacks of these systems by enabling a continuously variable angle of approach, while at the same time keeping the point of the probe/tool fixed at the target site (Virtual Point™). Applications are numerous and include:

Microelectronics (MEMS, NEMS), semi-conductor, photonics, fiber optics, micro-manufacturing

- Microscopy and microcircuit inspection and QC – microscope camera can be fitted to the linear axis of RoboMate
- Micro and nano positioning
- Microchip probing, re-work and prototyping
- Laser and fiber optic alignment
- Laser damage testing
- X Ray orientation
- Ultra-fine assembly, probing, soldering & testing

Biology and Medicine

- Micropositioning (electrophysiology, e.g. patch clamping)
- Microinjection
- Microscopy – microscope camera can be fitted to the linear axis of RoboMate
- Microsurgery
- X Ray orientation

For further information and OEM inquiries please contact Discovery Technology International or your local distributor

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