一维(X 轴)亚纳米定位工作台

AU-NPS-X 系列纳米定位工作台最初的设计是为了满足超快速度和超精密的应用。纳米定位工作台采用压电陶瓷直推驱动，以柔性铰链为运动副，使其结构紧凑、拥有小的体积、无摩擦、无间隙、定位分辨率高等优点。

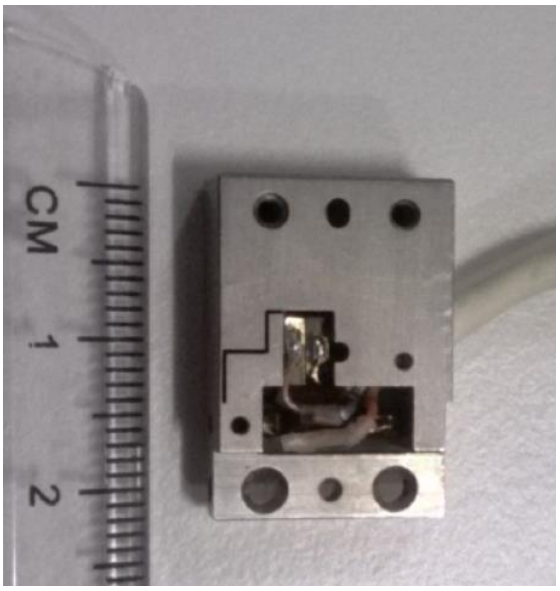
全行程采用电容位移传感器闭环反馈控制系统设计，电容位移传感器是将位移变化转换为电容电量信号的变化。电容位移传感器简单易用，而且拥有极高的精度，可达到亚纳米量级。结合数字闭环控制器，纳米定位工作台的响应时间和稳定时间可达到毫秒量级。低的移动质量和高的刚度结合可以提供非常高的带宽。

对于大行程的纳米定位台，采用目前业内最尖端的双传感技术与以往相比可以提供更快的响应速度，提高有效载荷出现变化时的稳定性和更高的带宽。这项突破性的技术能够应用于各种袖珍模拟和数字控制器，其操作简便，为用户提供顶尖性能。

上海昊量光电设备有限公司的一维纳米定位工作台主要包含以下几款产品：

①超紧凑型闭环亚纳米微动台

AU-NPS-X-5A 是一款已推出全球市面上体积最小的闭环一微亚纳米级别的微动台。体积只有 23 x 16.5 x 7.6 mm（长×宽×高）。应用电容位移传感器，位移分辨率达到亚纳米级别。空载下的自振频率更是高达 8000HZ。采用铝合金材质，其拥有较轻的质量和高的刚度，使其有高的带宽，在最大负载的情况下响应时间可达到亚毫秒级别。



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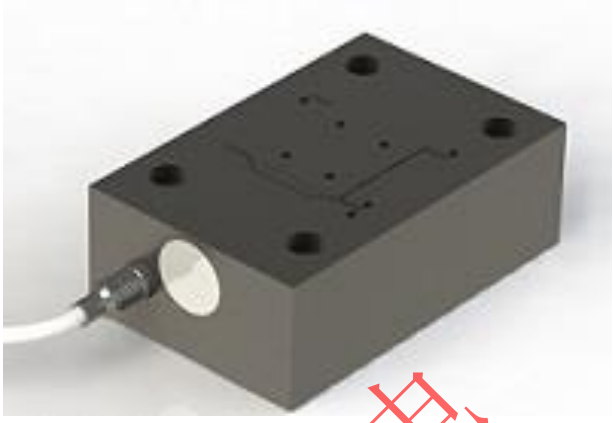
②超快一维亚纳米定位平台

AU-NPS-X-10A 是一款超快的一维亚纳米微动台，用于高速的、超精密的应用。该设备在空载下的自振频率高达 9500HZ。在 7g 负载的情况下仍可达到 8700HZ。并且该产品具有良好的位置重复性。拥有良好的响应速度，响应时间达到毫秒量级。并且该款产品可按照不同需求进行工业定制。

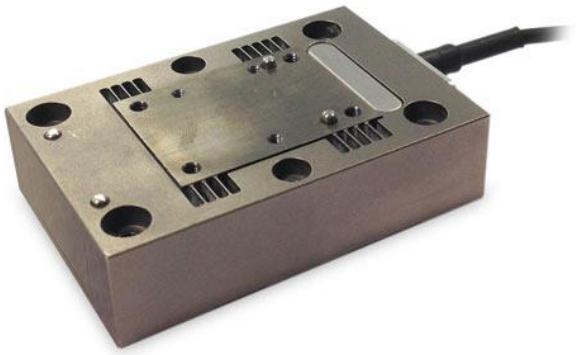


③超大行程的一维纳米微动台

AU-NPS-X-500A 采用**压电陶瓷直推驱动**，以**柔性铰链**为运动副，使其具有较紧凑的体积，使用电容传感器，在整个行程中分辨率精度可高达亚纳米级别。使用双传感设计，可提供更快的阶跃响应，提高有效载荷出现变化时的稳定性，并拥有更大的带宽，使其拥有更快的响应时间。

④高负载大推力一维亚纳米微动台

AU-NPS-X-30B 是一款高负载的微动台，最高负载可高达 10kg。其拥有极宽的带宽高达 1KHZ。空载下的自振频率更是高达 5000HZ。



除了以上几款产品 AU-NPS-X-15A/15D 这两款亚纳米一维微动台也拥有优异的性能。外加负载可高达 5kg。拥有较高的带宽，在 50g 负载的情况下，响应时间可达毫秒量级。AU-NPS-X-15D 和 AU-NPS-X-15A 属于相同型号，但是具有更高的高度（15.5mm），因此拥有更高的刚度，因此具有较宽的带宽、较低的稳定时间和较高的自振频率。

◆主要特点

- 亚纳米的分辨率
- 高的带宽
- 高速响应
- 高的可靠性
- 结构紧凑
- 压电陶瓷驱动
- 柔性铰链设计
- 电容位移传感器闭环反馈

◆主要应用

磁头和磁盘驱动测试、计量学、干涉度量学、原子力显微镜等

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◆产品主要参数

AU-NPS-X-5A

Specification

Parameter	Symbol	Value			Units	Comments
Static physical						
		Minimum	Typical	Maximum		
Material		Aluminium				
Size		23 long x 16.5 wide x 7.6 high			mm	
*Range	$d_{xp\text{-}max}$		6.5		µm	
Scale factor	b_{x1}		1		µm	Note 1
*Scale factor error (1σ)	δb_{x1}		<0.1		%	
Resonant frequency: 0g load	$f_{0\text{-}0}$		8000		Hz	
Maximum load				5	g	Note 2
Dynamic physical (Typical values)						
3dB Bandwidth	$B_{x\text{-}p}$		500		Hz	
*Small signal settle time	$tx_{s\text{-}s}$		1.6		ms	Note 3
*Position noise (1σ)	$\delta x_{p\text{-}n}$		0.1		nm_{rms}	Note 4
Error terms						
*Hysteresis (peak to peak)	$\delta_{xp\text{-}hyst}$		0.1	0.2	%	Note 5
*Linearity error (peak)	$\delta_{xp\text{-}lin}$		0.1	0.2	%	Note 6

Notes

*These parameters are measured and supplied with each mechanism

1. All position commands are given in micrometers with seven digit resolution.
2. This is the maximum load for gravity acting in the Z-direction to avoid damage to the stage mechanism.
3. This is the 2% settle time. It is a function of the servo loop parameters which are user controllable. The test step size is 500 nm.
4. The actual position noise of the stage.
5. Percent of the displacement. The hysteresis specification for a displacement of less than 1µm amplitude is 0.1 nm.
6. Percent error over the full range of motion.

AU-NPS-X-10A

Specification

Parameter		Symbol	Value			Units	Comments
Static physical							
			Minimum	Typical	Maximum		
Material			Titanium				
Size			62 long x 40 wide x 22 high			mm	
*Range		$d_{xp\text{-}max}$	± 5	± 6		µm	
Scale factor		b_{x1}		1		µm	Note 1
*Scale factor error (1σ)		δb_{x1}		0.02	0.1	%	
Resonant frequency:	0g load	$f_{0\text{-}0}$		9500		Hz	
	5.5g load	$f_{0\text{-}5.5}$		8900		Hz	
	7g load	$f_{0\text{-}7.0}$		8700		Hz	
Maximum load					0.2	Kg	Note 2
Dynamic physical (Typical values)							
			Fast	Medium	Slow		
3dB Bandwidth		$B_{x\text{-}p}$		300		Hz	
*Small signal settle time		$t_{xs\text{-}s}$		1.0		ms	Note 3
*Position noise (1σ)		$\delta x_{p\text{-}n}$	0.05	0.07	0.1	nm_{rms}	Note 4
Error terms							
			Minimum	Typical	Maximum		
*Hysteresis (peak to peak)		$\delta_{xp\text{-}hyst}$		0.005	0.01	%	Note 5
*Linearity error (peak)		$\delta_{xp\text{-}lin}$		0.01	0.02	%	Note 6
*Rotational error		$\delta\phi_x$		1	2	µradians	Note 7
*Rotational error		$\delta\theta_x$		1	10	µradians	Note 7
*Rotational error		$\delta\gamma_x$		1	2	µradians	Note 7

Notes

*These parameters are measured and supplied with each mechanism

1. All position commands are given in micrometers with seven digit resolution.
2. This is the maximum load for gravity acting in the Z-direction to avoid damage to the stage mechanism.
3. This is the 2% settle time. It is a function of the servo loop parameters which are user controllable. The test step size is 500 nm.
4. The actual position noise of the stage.
5. Percent of the displacement. The hysteresis specification for a displacement of less than 1µm amplitude is 0.1 nm.
6. Percent error over the full range of motion.
7. Angular motion over the full range of the stage. These rotational errors are rotational errors around the Z, Y and X axes respectively.

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AU-NPS-X-500A

Technical Specification

Parameter	Value	Unit	Tolerance	Note
Material	Titanium & Aluminium Alloy	-	-	
Dimension	60 x 60 x 20	mm	±3%	
Mass	177	g	±5%	
Range	500	μm	min	
Resolution	1	nm	typical	With NPC-D 5110DS controller
Linearity	0.02	%	typical	
Rotation error	±10	μrad	typical	
Repeatability	±1	nm	typical	
Stiffness	0.5	N·μm-1	±20%	
Resonant frequency unloaded	260	Hz	±20%	
Resonant frequency 20g	240	Hz	±20%	
Resonant frequency 120g	200	Hz	±20%	
Max load	1000	g	max	
Small signal settling time	10	ms	typical	
Cable Length	2	m	±20mm	

AU-NPS-X-30B

Specification

Parameter	Symbol	Value			Units	Comments
Static Physical						
		Minimum	Typical	Maximum		
Material		Titanium				
Size		60 long x 40 wide x 15.5 high			mm	
*Range	$d_{x.p}$ max	± 15			μm	
Scale factor	$bx1$				μm	Note 1
Scale factor error (1σ)	$\delta bx1$		0.1		%	
Resonant frequency:	$f_{0.0}$	4.5	5		KHz	
Maximum load				10	Kg	Note 2
Dynamic Physical (typical values)						
		Fast	Medium	Slow		Note 3
3dB Bandwidth	$B_{x.p}$	600	400	50	Hz	
*Small signal settle times	$t_{x\sigma.s}$	1			ms	Note 4
*Position noise (1σ)	$\delta x_{p.n}$	0.12	0.09	0.04	nm_{rms}	Note 5
Error terms						
		Minimum	Typical	Maximum		
*Hysteresis (peak to peak)	$\delta_{xp\text{-}hyst}$		0.005	0.01	%	Note 7
*Linearity error (peak)	$\delta_{xp\text{-}ln}$		0.01	0.02	%	Note 8
*Rotational error	$\delta\varphi_x$		1	5	μradians	Note 9
* Rotational error	$\delta\theta_x$		1	5	μradians	Note 9
* Rotational error	$\delta\gamma_x$		1	5	μradians	Note 9

Notes

*These parameters are measured and supplied with each mechanism.

1. All position commands are given in micrometers with seven digit resolution.
2. This is the maximum load for gravity acting in the Z-direction to avoid damage to the stage mechanism.
3. For dynamic operation the servo-loop parameters are preset for different performances; the parameters are user settable via software control. Fast means the fastest the stage can stably move with less than 50 grams load. Medium means the maximum stable speed for loads up to 200 grams. Slow means the speed at which the servo loop is stable for loads up to 500 grams – equivalent to low noise setting.
4. This is the 2% settle time. It is a function of the servo loop parameters which are user controllable. The test step size is 500 nm.
5. The actual position noise of the stage.
6. The highest rate of change of true position with time that can be achieved. It is limited by the closed loop parameters; the absolute maximum value (in open loop operation) is ~3.5 μm•ms-1.
7. Percent of the displacement. The hysteresis specification for a displacement of less than 1μm amplitude is 0.1 nm.
8. Percent error over the full range of motion.
9. Angular motion over the full range of the stage. These rotational errors are rotational errors around the Z, Y and X axes respectively.

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AU-NPS-X-15A(AU-NPS-X-15D)

Specification Values for AU-NPS-X-15D in parenthesis

Parameter	Symbol	Value			Units	Comments
Static physical						
		Minimum	Typical	Maximum		
Material		Stainless steel 316				
Size		60 long x 40 wide x 13.5 high (60x40x15.5)			mm	
*Range	$d_{xp\cdot max}$	± 7.5	± 8		µm	
Scale factor	b_{x1}		1		µm	Note 1
*Scale factor error (1σ)	δb_{x1}		0.1		%	
Resonant frequency: 0g load	$f_{0\cdot0}$	3000 (3500)			Hz	
50g load	$f_{0\cdot50}$		2500 (2900)		Hz	
200g load	$f_{0\cdot200}$		1500 (1750)		Hz	
Maximum load				5	Kg	Note 2
Dynamic physical (typical values)						
		Fast	Medium	Slow		Note 3
3dB Bandwidth	$B_{x\cdot p}$	250 (300)	170 (200)	35 (35)	Hz	
*Small signal settle time	$t_{xs\cdot s}$	1.7 (1.5)	4.3 (3.5)	25 (25)	ms	Note 4
*Position noise (1σ)	$\delta x_{p\cdot n}$	0.2	0.1	0.05	nm_{rms}	Note 5
Slew rate	$u_{xp\cdot max}$	2	1	0.2	µm/ms	Note 6
Error terms						
		Minimum	Typical	Maximum		
*Hysteresis (peak to peak)	$\delta_{xp\cdot hyst}$		0.005	0.01	%	Note 7
*Linearity error (peak)	$\delta_{xp\cdot lin}$		0.01	0.02	%	Note 8
*Rotational error	$\delta\varphi_x$		1	5	µradians	Note 9
*Rotational error	$\delta\theta_x$		1	5	µradians	Note 9
*Rotational error	$\delta\gamma_x$		1	5	µradians	Note 9

Notes

*These parameters are measured and supplied with each mechanism

1. All position commands are given in micrometers with seven digit resolution.
2. This is the maximum load for gravity acting in the Z-direction to avoid damage to the stage mechanism.
3. For dynamic operation the servo-loop parameters are preset for different performances; the parameters are user settable via software control. Fast means the fastest the stage can stably move with less than 50 grams load. Medium means the maximum stable speed for loads up to 200 grams. Slow means the speed at which the servo loop is stable for loads up to 500 grams – equivalent to low noise setting.
4. This is the 2% settle time. It is a function of the servo loop parameters which are user controllable. The test step size is 500 nm.
5. The actual position noise of the stage.
6. The highest rate of change of true position with time that can be achieved. It is limited by the closed loop parameters; the absolute maximum value (in open loop operation) is ~3.5 $\mu m \cdot ms^{-1}$.
7. Percent of the displacement. The hysteresis specification for a displacement of less than 1µm amplitude is 0.1 nm.
8. Percent error over the full range of motion.
9. Angular motion over the full range of the stage. These rotational errors are rotational errors around the Z, Y and X axes respectively.

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