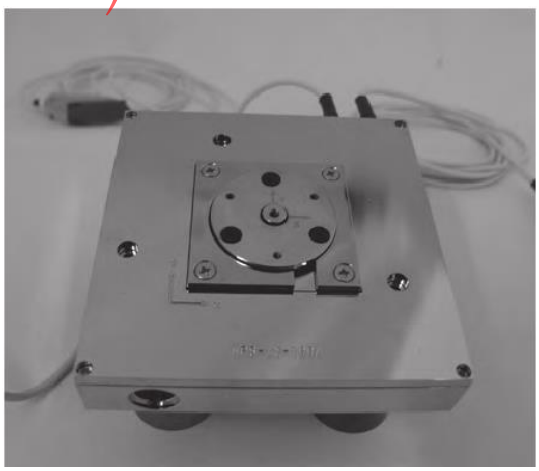
三维纳米定位工作台

AU-NPS-XYZ 系列纳米三维维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。

该三维微动台采用超级不胀钢（因瓦合金）结构，其热膨胀系数极小达到 0.3ppm K^{-1}，使热漂移达到最小，这对于纳米级的工作台来说是极其重要的。AU-NPS-XYZ 系列微动台采用是由 AU-NPS-XY-100A 二维微动台与 Z 轴运动的一维微动台组合而成。因此三维微动台可以在 X,Y 方向可以分别提供 100 微米的闭环行程，在 Z 轴方向上可以提供 15 微米的闭环行程。而且可以提供四种不同的安装配置，使其满足不同的安放位置的需求。

AU-NPS-XYZ-100/Z15A 是由二维亚纳米扫描台 AU-NPS-XY-100A 与单轴 Z 向扫描台 AU-NPS-Z-15A 组合而成，因此该扫描台集合了二者的优势。在 X 轴和 Y 轴提供 120 微米的闭环行程，在 Z 轴提供 16 微米的行程，采用电容位移传感器，分辨率可达亚纳米级别。并且拥有极佳的线性和极低的迟滞。材质采用不胀钢，使其拥有极低的热漂移。



AU-NPS-XYZ-100/Z15H 由 AU-NPS-XY-100A 和 AU-NPS-Z-15H 组合而成，因此这款三维扫描台性能与上一款性能相似。不同的是 AU-NPS-Z-15H 平台为中空的。

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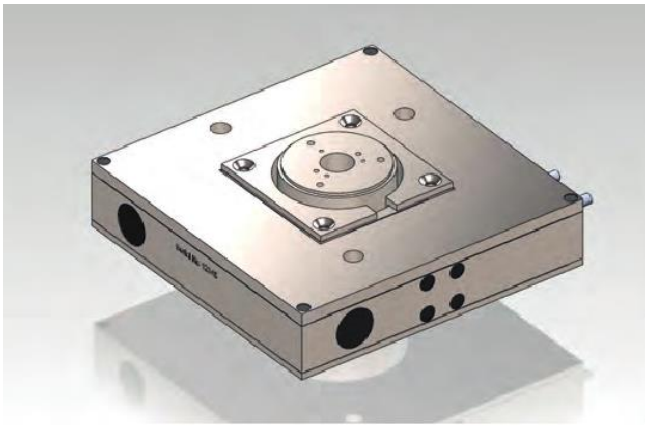

◆主要特点

- 亚纳米级的分辨率
- 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
- 安装简单和简单的图像校准
- 电容位移传感器闭环反馈
- 迟滞/线性误差<0.005%

◆主要应用

高精度显微镜、投射显微镜、光学追踪、原子力显微镜、近场扫描光学显微镜、双光子显微镜等。

◆主要参数

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AU-NPS-XYZ-100/Z15A

Specification

Axis	Parameter	Symbol	Value			Units	Comments
XY	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar				
	Size		100 x 100 x 48			mm	Note 1
	*Range	$d_{xp.max}$	± 50	± 55		μm	
	*Scale factor	b_{x1}		1		μm	Note 2
	Scale factor error (1σ)	δb_{x1}			0.1	%	
	Static stiffness	k_x		1		N·μm^{-1}	
XY	**Dynamic physical (Typical values)**						
	Loop Settings		Fast	Medium	Slow		Note 3
	*Bandwidth	$B_{x\cdot p}$	90	30	20	Hz	
	*Small signal settle time	$t_{xs\cdot s}$	10	20	130	ms	Note 4
	*Position noise (1σ)	$\delta x_{p\cdot n}$	0.4	0.3	0.1	nm	Note 5
	Slew rate	$u_{xp.max}$	3	2	0.5	μm·ms^{-1}	Note 6
XY	**Error terms**						
	*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	$\delta\phi_x$		10	25	μrad	Note 9
	*Rotational error	$\delta\theta_x$		2	10	μrad	Note 9
	*Rotational error	$\delta\gamma_x$		2	10	μrad	Note 9
Z	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar				
	*Range	$d_{xp\cdot max}$	± 7.5	± 8.5		μm	
	*Scale factor	b_{x1}		1		μm	Note 2
	Scale factor error (1σ)	δb_{x1}			0.1	%	
Z	**Dynamic physical (Typical values)**						
	Loop settings		Fast	Medium	Slow		Note 10
	*Position noise (1σ)	$\delta x_{p\cdot n}$	0.1	-	0.05	nm	Note 5
Z	**Error terms**						
	*Hysteresis (peak to peak)	$\delta_{xp\cdot hyst}$			0.05	%	Note 7
	*Linearity error (peak)	$\delta_{xp\cdot lin}$		0.01	0.02	%	Note 8
	*Rotational error	$\delta\phi_x$		10		μrad	Note 9
	*Rotational error	$\delta\theta_x$		5		μrad	Note 9
	*Rotational error	$\delta\gamma_x$		5		μrad	Note 9

Notes

*These parameters are measured and supplied with each mechanism

1. No central aperture.
2. All position commands are given in micrometers with seven digit resolution.
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 speed for loads up to 200 grams. Slow means the speed at which the servo loop is stable for all masses up to the maximum allowed mass - equivalently low noise setting.This is the maximum load for gravity acting in the Z-direction to avoid damage to the stage mechanism.
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 2000 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.
10. For dynamic operation the servo loop parameters are preset for different performances; the parameters are user settable via software control. Percent error over the full range of motion.

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AU-NPS-XYZ-100A/Z15H

Specification

Axis	Parameter	Symbol	Value			Units	Comments
XY	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar (Bright nickel plated)				
	Size		100 x 100 x 38.5			mm	Note 1
	*Range	$d_{xp\cdot max}$	± 50 ±	55		µm	
	*Scale factor	b_{x1}		1		µm	Note 2
	Scale factor error (1σ)	δb_{x1}			0.1	%	
	Static stiffness	k_x		1		N·µm^{-1}	
	Resonant frequency: 0g load	$f_{0\cdot0}$		350		Hz	
	50g load	$f_{0\cdot50}$		260		Hz	
	1000g load	$f_{0\cdot1000}$		120		Hz	
	Maximum load				1	Kg	Note 3
XY	**Dynamic physical (Typical values)**						
	Loop settings		Fast	Medium	Slow		Note 4
	Bandwidth	$B_{x\cdot p}$	53	20	4	Hz	
	*Small signal settle time	$t_{xs\cdot s}$	15	30 1	30	ms	Note 5
	*Position noise (1σ)	$\delta x_{p\cdot n}$	0.7	0.5	0.25	nm	Note 6
	Slew rate	$u_{xp\cdot max}$	3	2	0.5	µm·ms^{-1}	Note 7
XY	**Error terms**						
	*Hysteresis (peak to peak)	$\delta_{xp\cdot hyst}$		0.005	0.01	%	Note 8
	*Linearity error (peak)	$\delta_{xp\cdot lin}$		0.01	0.02	%	Note 9
	*Rotational error	$\delta\varphi_x$		10	25	µrad	Note 10
	*Rotational error	$\delta\theta_x$		5	10	µrad	Note 10
	*Rotational error	$\delta\gamma_x$		5	10	µrad	Note 10
	Orthogonality	$d\,f_{orth}$		8		mrad	
Z	**Static physical**						
			Minimum	Typical	Maximum		
	Material		Super Invar				
	*Range	$d_{xp\cdot max}$	± 7.5 ±	8.0		µm	
	*Scale factor	b_{x1}				µm	Note 2
	Scale factor uncertainty (1s)	δb_{z1}			0.1	%	
	Static stiffness	k_z		20		N·µm^{-1}	
	Resonant frequency: 0g load	$f_{0\cdot0}$		900		Hz	
	Maximum load				0.5	kg	Note 3

Z	Dynamic physical (Typical values)						
	Loop settings		Fast	Medium	Slow		Note 4
	3dB Bandwidth	$B_{z\cdot p}$	80	40	10	Hz	
	*Small signal settle time	$t_{zs\cdot s}$	5	10	30	ms	Note 5
	*Position noise (1s)	$\delta z_{p\cdot n}$	0.5	0.2	0.1	nm	Note 6
	Slew rate	$u_{zp\cdot max}$	2	1	0.5	µm·ms^{-1}	Note 7
Z	**Error terms**						
	*Hysteresis (peak to peak)	$\delta_{zp\cdot hyst}$		0.005	0.02	%	Note 11
	*Linearity error (peak)	$\delta_{zp\cdot lin}$		0.01	0.02	%	Note 9
	*Rotational error	$\delta\theta_z$			10	µrad	Note 10
	*Rotational error	$\delta\gamma_z$			10	µrad	Note 10

Notes

*These parameters are measured and supplied with each mechanism

1. With 10 mm diameter central aperture. Includes Z Stage.
2. All position commands are given in micrometers with seven digit resolution.
3. Depends on orientation. 1kg is the maximum load for gravity acting in the Z direction. 0.5kg is the maximum load for gravity acting in the X or Y axes. Loads greater than 5kg can cause damage to the flexure mechanism.
4. 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 speed for loads up to 200 grams. Slow means the speed at which the servo loop is stable for all masses up to the maximum allowed mass - equivalently low noise setting.
5. 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.
6. The actual position noise of the stage.
7. 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}.
8. Percentage of the displacement. The hysteresis specification for a displacement of less than 1µm amplitude is 0.1 nm.
9. Percent error over the full range of motion.
10. Angular motion over the full range of the stage. These rotational errors are rotational errors around the Z, Y and X axes respectively.
11. Percentage of the displacement. The hysteresis specification for a displacement of less than 1µm amplitude is 0.2nm.

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