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Microscanning is a key technique in high-resolution IR imaging field. It allows to increase the system resolution and improve the performance of imaging systems. This technique requires repeatability and short response time.

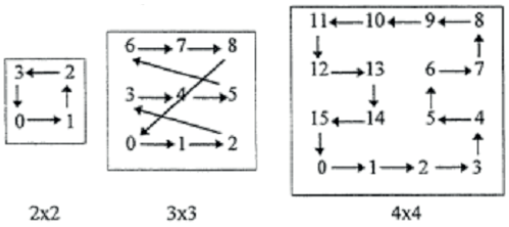

Fig. 1: Typical microscanning patterns

PRINCIPLE

Two technologies are proposed by CEDRAT TECHNOLOGIES (CTEC): moving a lens with a XY25XS Stage or tilting a mirror with a DTT15XS mechanism.

Microscanning technique consists in taking multiple images of the same scene, according to different pattern (Fig.1), while displacing each time the image over the detector plan by a distance equal to a fraction of the detector pitch. The under-sampled frames of the scene are then used to form a single high-resolution frame.

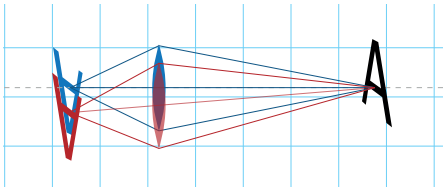

Fig. 2: Lens based microscanning system

The XY25XS piezo stage shifts a focussing lens in the focal plane array along 2 axis X & Y (Fig.2).

The DTT15XS mechanism tilts a mirror along 2 axis X & Y (Fig.3)

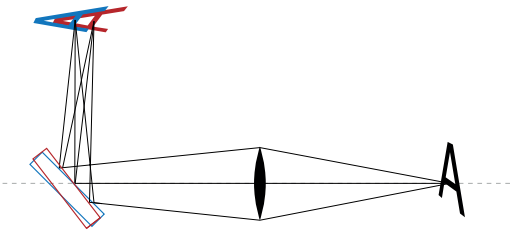

Fig. 3: Mirror-based microscanning system

MICROSCANNING WITH A XY STAGE

> STRUCTURE

The piezoelectric stage XY25XS (Fig.4) is based on standard Amplified Piezo Actuator (APA®) and owns high stiffness. The stage can be equipped with Strain Gauges to get a very fine accuracy. Parasitic rotations are very limited. This compact stage can be customised in order to meet specifications in terms of mechanical integration and environment on board IR camera (Fig.5).

Fig. 5: Catherine IR Camera using a customised XY25XS version, courtesy of Thales Optronique.

Fig. 4: Standard XY25XS piezoelectric stage

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> PERFORMANCES

Typical performances are given in the following table (Table 1). This table is not exhaustive as many other XY Piezo Stages have been designed by CTEC starting with similar or other standard amplified piezo actuators (see brochure XY stages heritage).

PARAMETER	UNIT	TYPICAL VALUE
> Quasistatic performances (1)		
Nominal stroke	µm	25
Minimal stroke	µm	20
Resolution (2)	nm	20
> Dynamic performances		
Unloaded Blocked - free resonance frequency (3)	Hz	2 200
Max. out of plane Z displacement	µrad	0.5
> Driving		
Voltage range	V	-20 to +150
Capacitance (4)	µF	<0.6
> Dimensions & interfaces		
Height (5)	mm	<18
Cross section (5)	mm	<50x50
Mass (5)	g	<80

Table 1: Performances of the standard XY25XS piezoelectric stage

Guaranted in labs environment. A misused can lead to temporary or definitive alterations of properties. Contact CEDRAT TECHNOLOGIES prior using actuators under non standard technical conditions

(1) AC voltage, full range @ 1Hz at Ambient Temperature
(2) With low noise amplifier SNR=80dB
(3) Blocked-free: The actuator is fixed to a mechanical support assumed infinitely stiff
(4) Per axis, quasistatic excitation, free-free, on the admittance curve
(5) Unloaded, excluding wires, without mirror

> REMARKS

Benefits of the CTEC XY piezo scanner for your IR Camera:

- Elimination of deleterious artifacts from staring arrays
- Elimination of aliasing and spurious response
- Quantitative resolution improvement
- Qualitative Image resolution improvement
- Minimum Resolvable Temperature (MRT) Difference improvement
- Stabilisation improvement / nulling out the residual gimbal jitter

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MICROSCANNING WITH A TIP TILT PLATFORM

> STRUCTURE

The piezoelectric DTT15XS (Fig.6) is based on standard Amplified Piezo Actuator (APA®) and owns high stiffness. The DTT mechanism can be equipped with a mirror and Strain Gauges to get a very fine accuracy. This DTT can be customised in order to meet specifications in terms of mechanical integration and environment on board IR camera.

Fig. 6: DTT15XS

> PERFORMANCES

PARAMETER	UNIT	TYPICAL VALUE
> Quasistatic performances (1)		
Nominal stroke	mrad (+/-)	1
Minimal stroke	mrad (+/-)	> 0.7
Resolution (2)	µrad	< 1
> Dynamic performances		
Unloaded Blocked - free resonance frequency (3)	Hz	> 3.000
loaded Blocked - free resonance frequency with rectangular glass mirror 52*42*4 mm (3)	Hz	> 1.700
> Driving		
Voltage range	V	-20 to +150
Capacitance (4)	µF	<0.6
> Dimensions & interfaces		
Height (5)	mm	<24
Cross section (5)	mm	<40x40
Mass (5)	g	<110

Table 2: Performances of DTT15XS

Guaranted in labs environment. A misused can lead to temporary or definitive alterations of properties. Contact CEDRAT TECHNOLOGIES prior using actuators under non standard technical conditions

(6) AC voltage, full range @ 1Hz at Ambient Temperature
(7) With low noise amplifier SNR=80dB
(8) Blocked-free: The actuator is fixed to a mechanical support assumed infinitely stiff
(9) Per axis, quasistatic excitation, free-free, on the admittance curve
(10) Unloaded, excluding wires, without mirror

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ADVANTAGES OF CTEC MECHANISMS (XY25XS & DTT15XS)

- Solid state design
- High speed
- Life time > 10^{10} cycles
- Low chromatic aberration
- Low electric consumption
- Centring in case of failure
- Thermally compensation
- Ease of implementation
- Compact solution

Compared to:

- Prism pair (chromatic aberration)
- Liquid crystals & polarizer (50% input signal attenuation)
- Moving FPA (complicated & limited performances),

KEYWORDS

Dithering, microscanning, XY piezo stage, piezo microscanner, IR camera resolution, Tip Tilt, Pixel Shift, Fast Steering Mirror,...

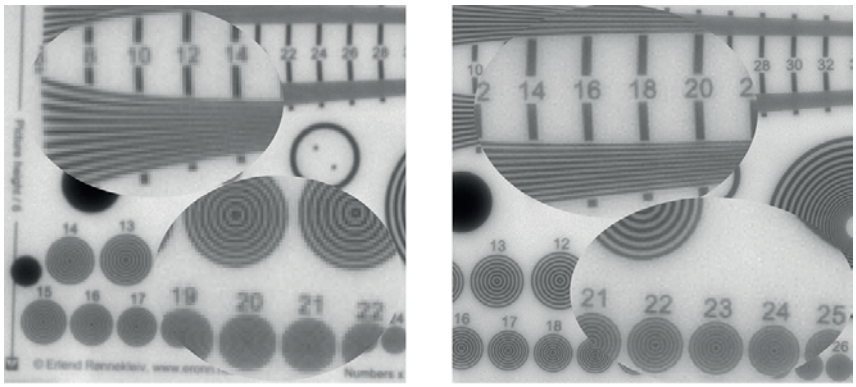

Fig. 7: Left without microscanning.
Right with microscanning