

Manufacturing Technology Conference 2023



Optical Inspection in Focus

Mitutoyo



TAGLENS and Pulsed Light Source

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- ❖ TAGLENS Principle
- ❖ Pulsed Light Source
- ❖ TAGLENS Features



Tunable
Acoustic
Gradient Index
LENS



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TAGLENS Components

Basic



[TAGPAK-C] Install on PC

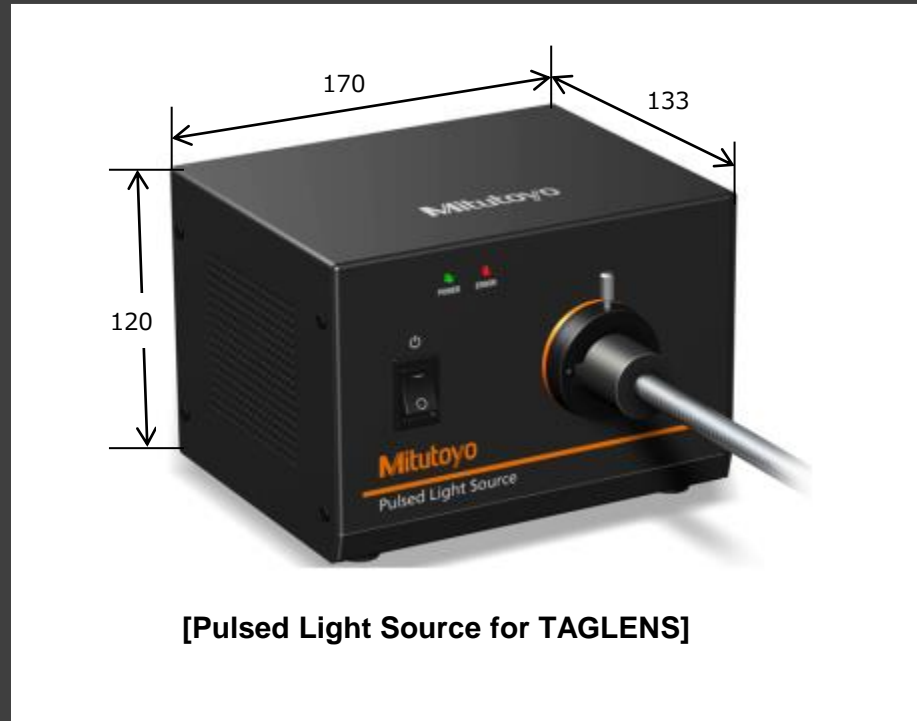
- Control TAGLENS through the Controller
- Included with SDK



[TAGPAK-E] Install on PC

- Image Display Viewer (EDOF/Multi-Focus, etc.)
- Included with SDK

Option





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TAGLENS Principle

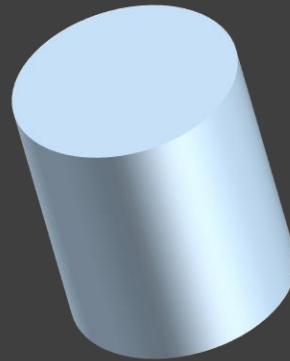
TAGLENS Principal



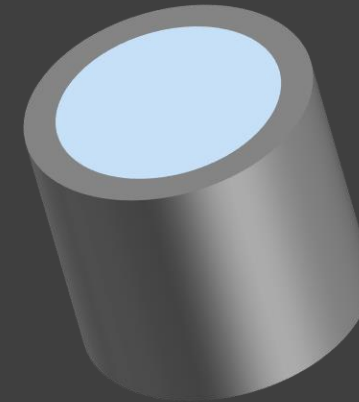
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Cylinder with silicon oil, surrounded by piezo elements

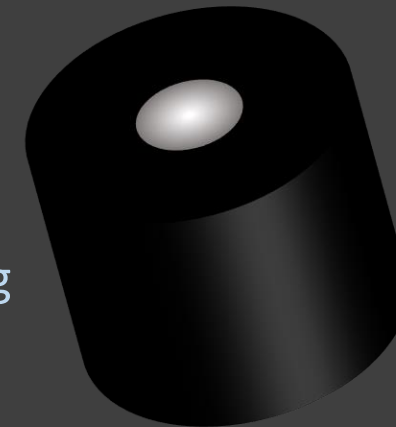
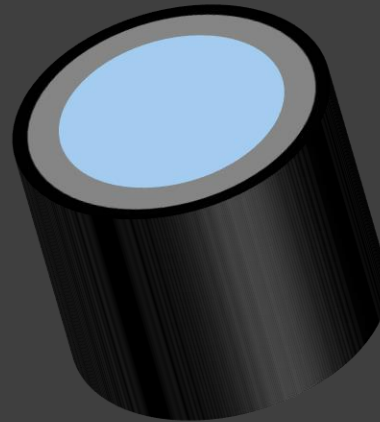
Silicon oil



Piezo elements

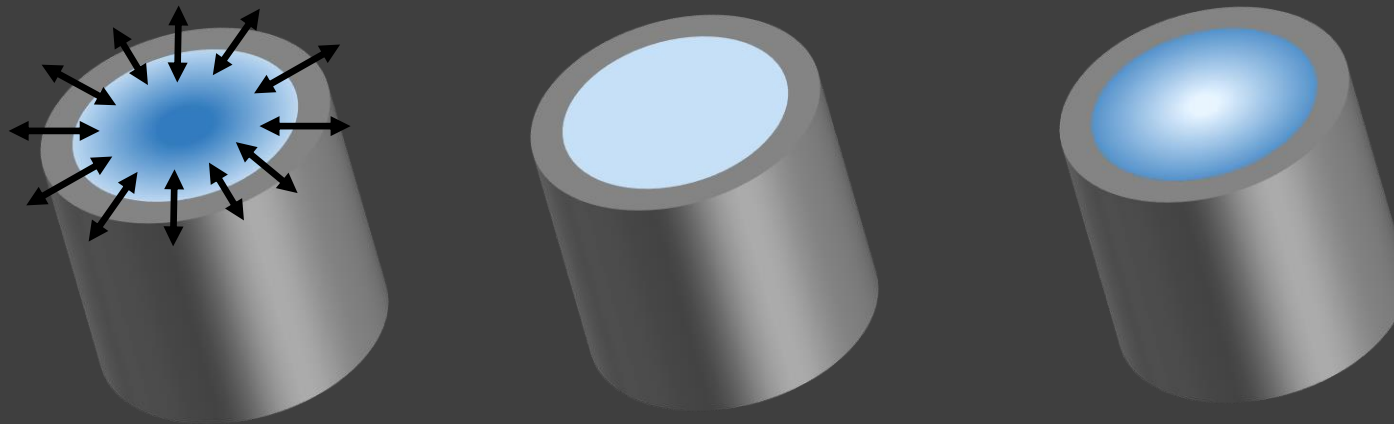


Housing



Radial, standing acoustic wave in silicon oil due to interference by piezo stimulation

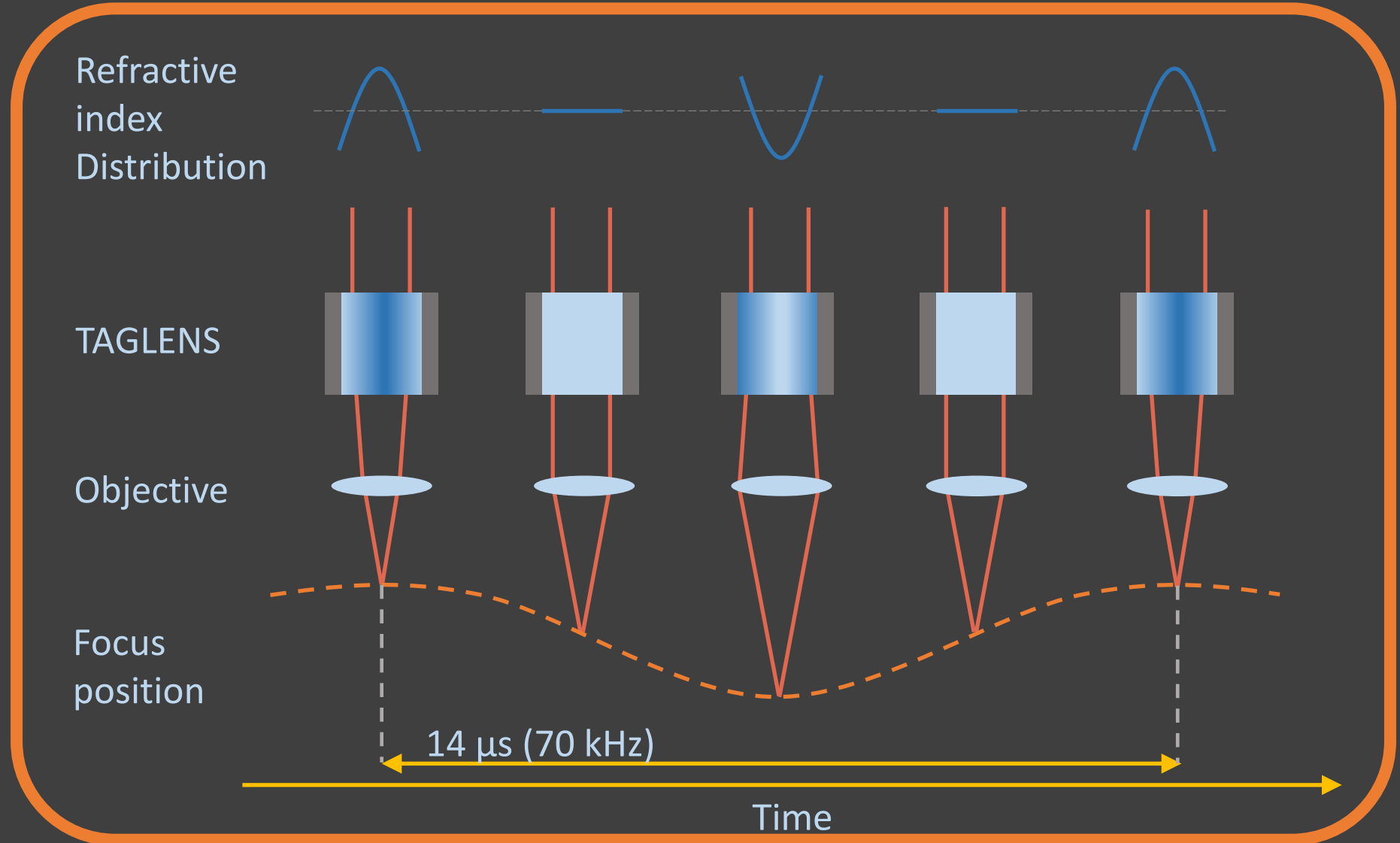
Density variation \rightarrow variation of refractive index



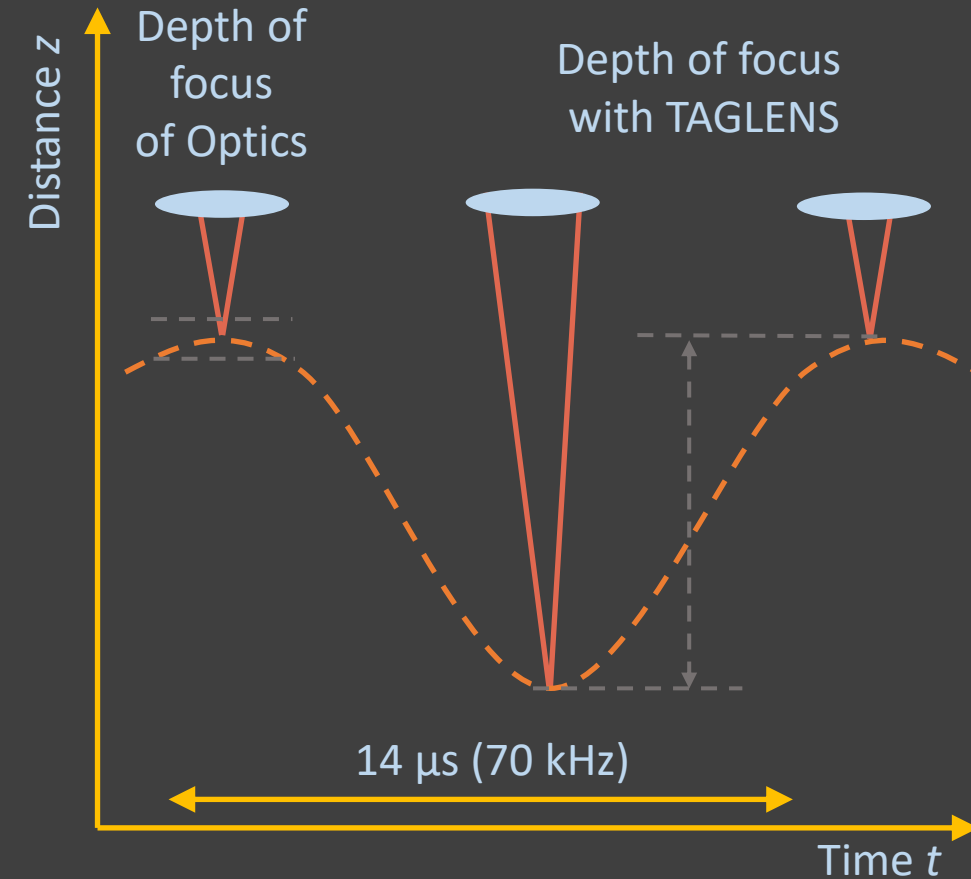
TAGLENS Principal



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Objective	Depth of focus (Objective)	Depth of focus (with TAGLENS)	Factor
FS 1x	880 μm	16,0 mm	18
FS 2x	180 μm	4,0 mm	22
FS 5x	28 μm	640 μm	23
FS 7.5x	12 μm	280 μm	23
FS 10x	7 μm	160 μm	23
FS 20x	3 μm	40 μm	13
FS 50x	1,8 μm	7 μm	3,8



TAGLENS Principal

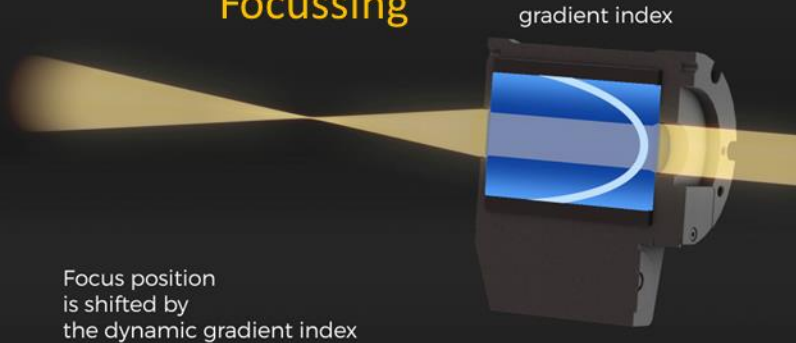


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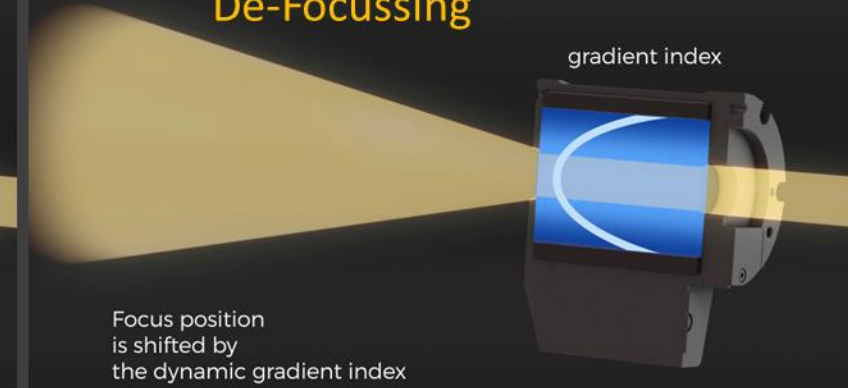
Piezo elements modulate the acoustic waves in the fluid



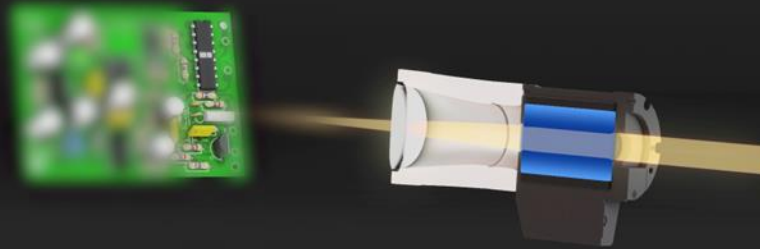
Focussing



De-Focussing

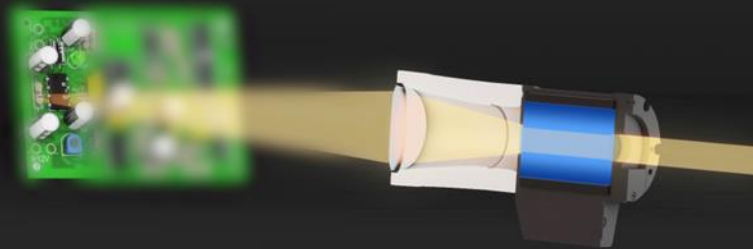


Near Focus



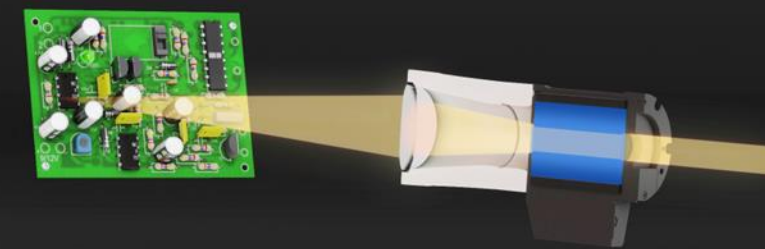
Capable of scanning objects 70,000 times per second

Far Focus



Capable of scanning objects 70,000 times per second

All-In-Focus



Capable of scanning objects 70,000 times per second
Creating an all in focus image

TAGLENS Principal



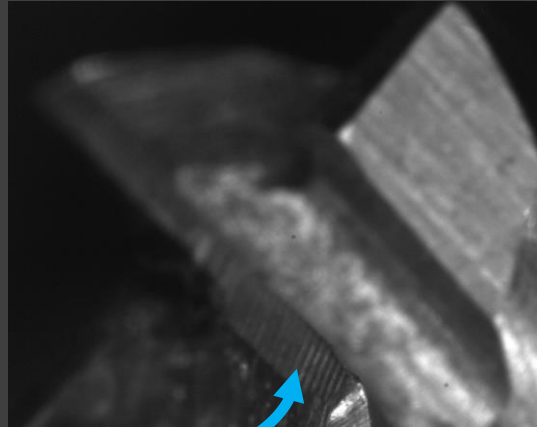
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Drill – Cutting Edge

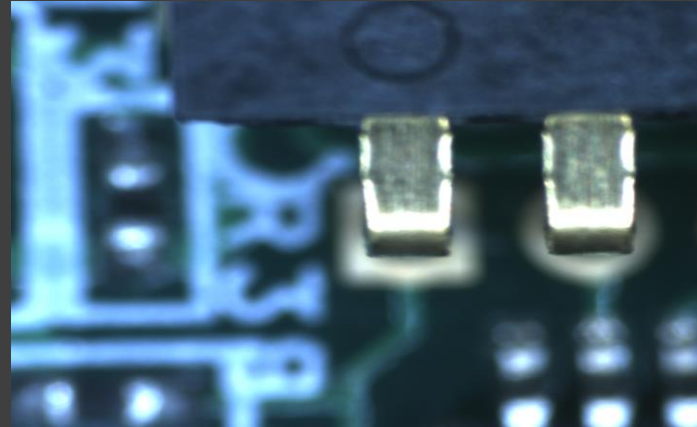
Electronic Board – Components

Clock – Gears

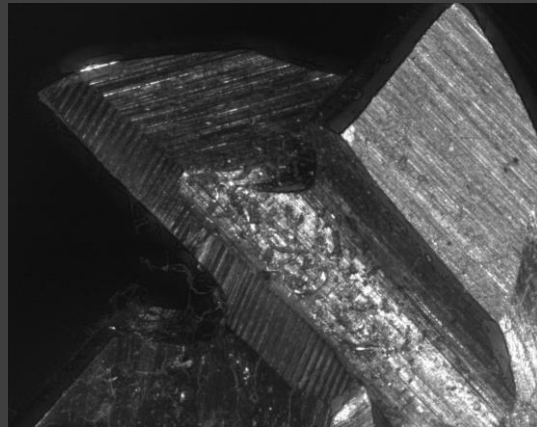
Without TAGLENS –
Standard optical system



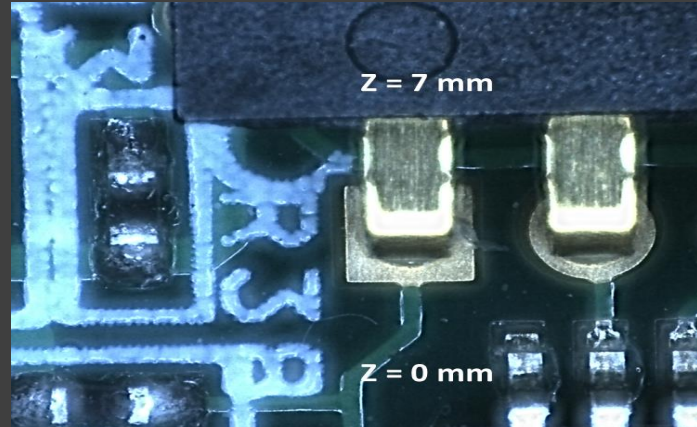
Tip in focus



With TAGLENS –
Composed image
EDOF



Everything in focus



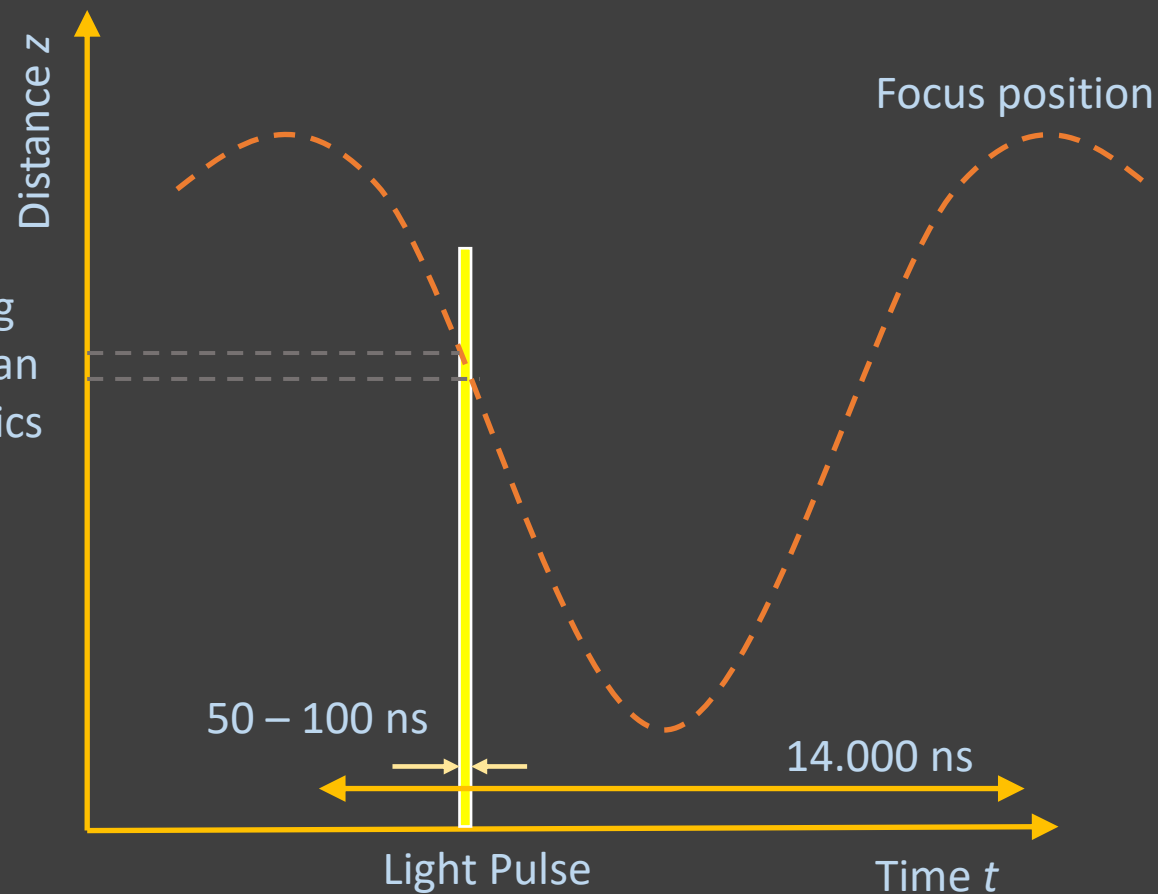
- Increased depth of field by a factor of 23x (depending on optics)
- Ultra fast focussing (70 khz) -> in line capable
- No mechanical moving parts
- All-in-focus images for 3D workpieces for inspection or defect detection
 - Different heights 3D Structures
 - Curved parts
- Very robust against position tolerances
- Arbitrary mounting orientation (vertical/horizontal)



Pulsed Light Source

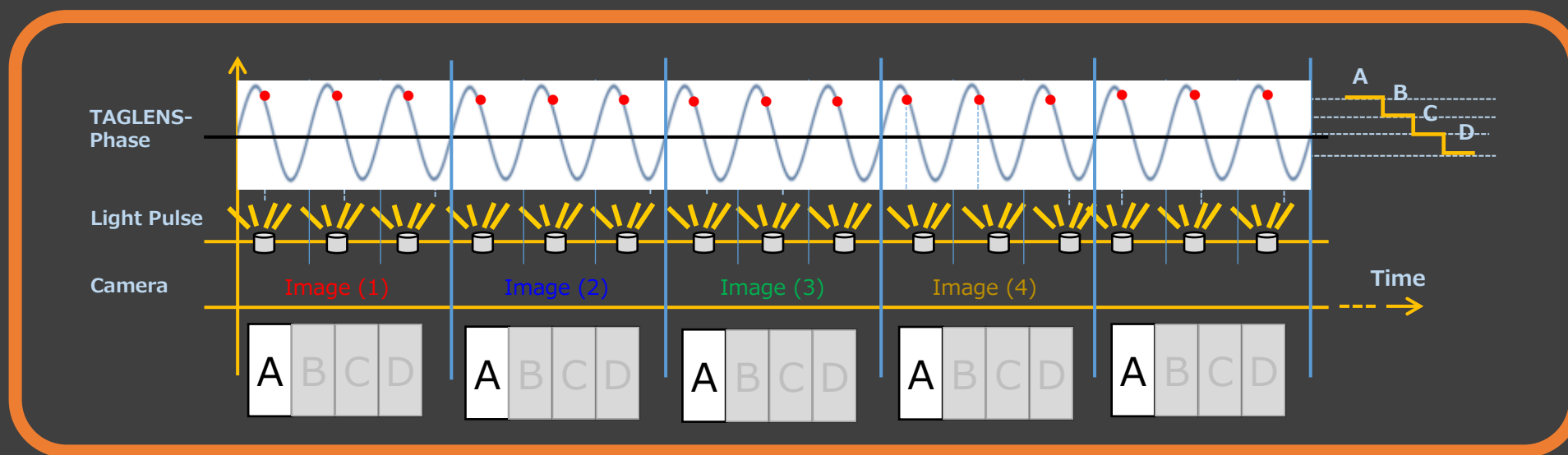
Pulsed Light Source (PLS)

Focus variation during light pulse smaller than depth of focus of optics



Pulsed Light Source synchronised with TAGLENS-Phase and Camera

Only one layer in focus



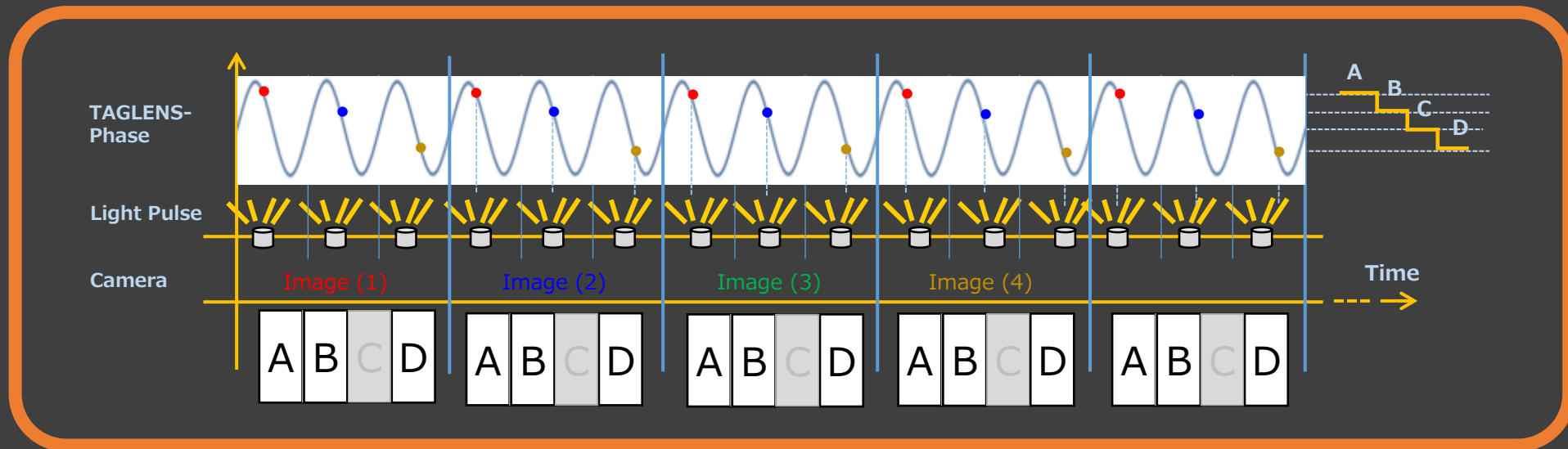
Typical camera: 70 Hz (fps)
TAGLENS: 70.000 Hz



ca. 1000 TAGLENS-Cycles in one camera image (frame)

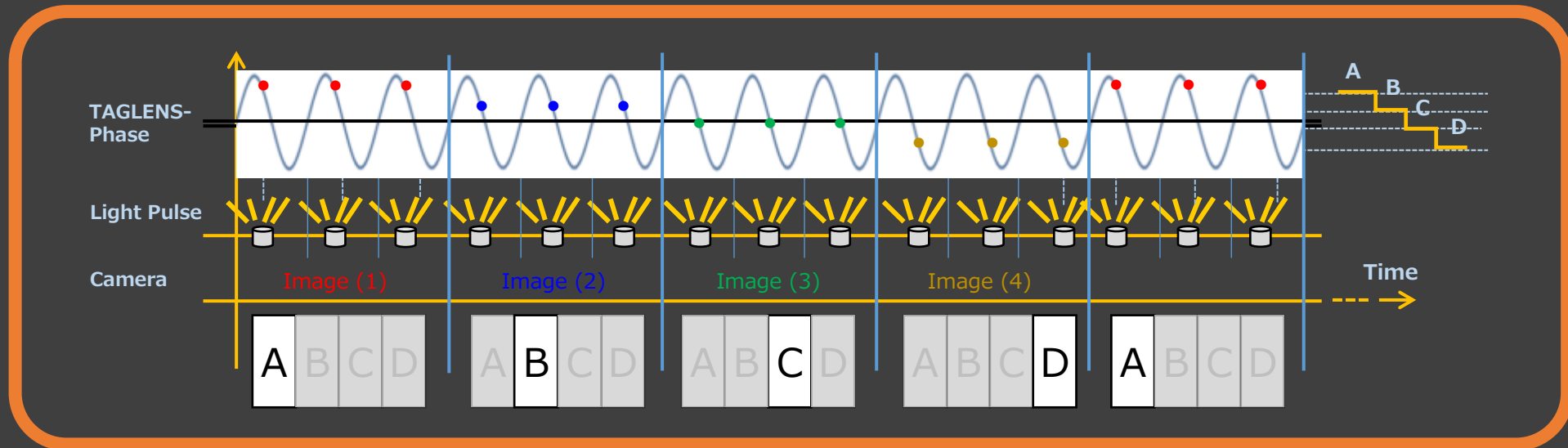
Pulsed Light Source synchronised with TAGLENS-Phase and Camera

Multiple focused layers in one image



Pulsed Light Source synchronised with TAGLENS-Phase and Camera

Shifting the focus after each image

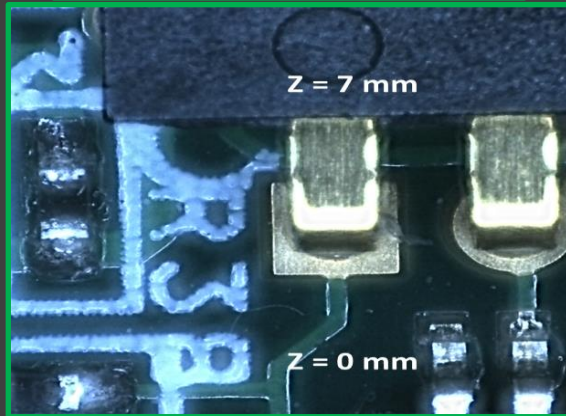


Many more operating modes with TAGLENS



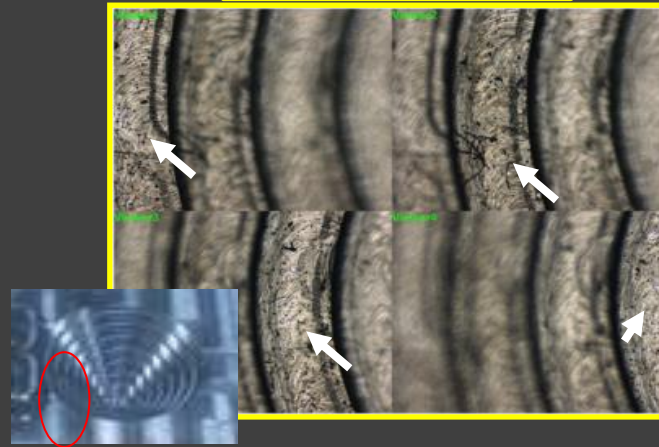
Standard: CW Light

Extended Depth Of Field

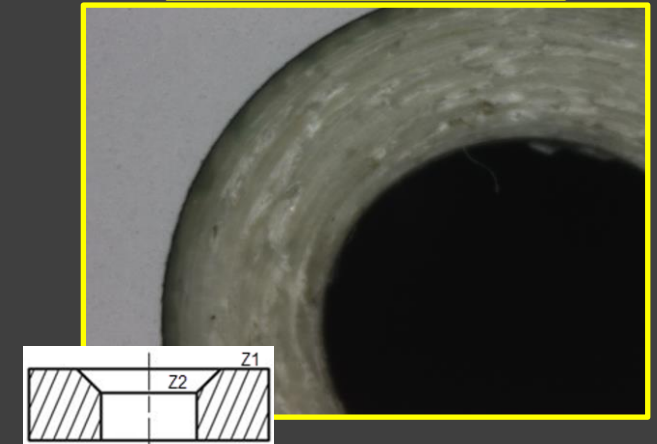


Optional: Pulsed Light

High Speed Focus



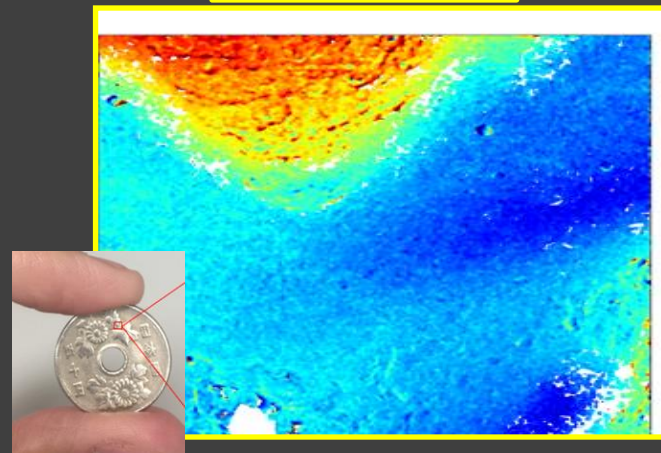
Multi-Plane Imaging



Composed 3D Image



3D Height Map



- 3D Presentations
- Switch between modes
- Integrable with robots
- Integrable with defect detection software
- Autofocus
- Focus stacking
-





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TAGLENS Features

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TAGLENS with CW Light:

- Extended depth of focus (22 times)
- All-in-focus images for 3D structures and curved surfaces

- **Examples:**
 - Optical inspection
 - Defect detection
 - In-Line image capturing
 - ...

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EXTENDED
DEPTH OF FOCUS



TAGLENS with pulsed light:

- Autofocus w/o moving parts
- Focus stacking
- 3D presentation
- Point clouds
- Height maps

- **Examples:**
 - Optical inspection with high speed AF
 - Microscopic height measurements
 - Fast autofocus for inspection
 - ...

TAGLENS with low power* Laser:

- Laser line instead of laser point*
- Examples:
 - Fluorescence microscopy
 - ...

* max. $\sim 500\text{mW/cm}^2$

Thank you

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Thank you for your attention

Knowledge
Sharing Centre

Open platform for knowledge sharing with first members:

ASML

ThermoFisher
SCIENTIFIC

hi holland
innovative

MIKRO
CENTRUM
at the heart
of hightech

INNOVOX & Partners
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