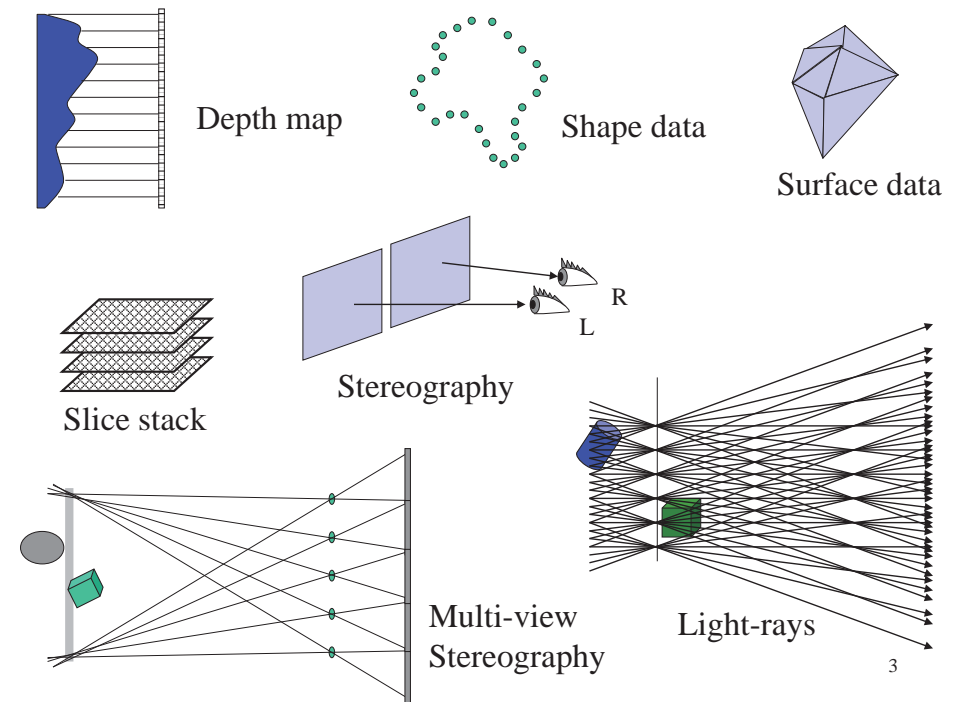


# 光画像工学

## Optical imaging and image processing

### (XII)

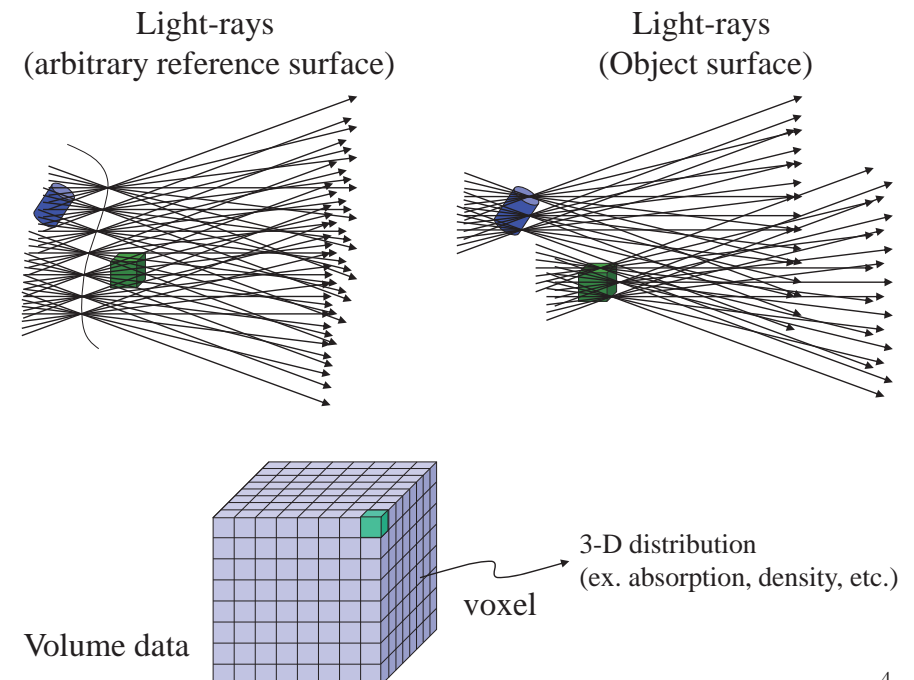


## 6. 三次元画像とホログラフィー

## 6. Three-dimensional imaging and holography

### 6.1 Variations of 3-D information

Type	Parameters	Amount of data
2D image	$x, y, \text{value}$	$N^2 \times L_b$
Depth map	$x, y, \text{depth}$	$N^2 \times L_d$
Shape data	$x, y, z$	$3P \times X$
Surface data	$x, y, z, \text{reflectivity}$ $x, y, z, \text{color}$	$3P \times L_b \times X$
Slice stack	$x, y, \text{value}, \text{number}$	$N^2 \times L_b \times D$
Stereography	$x, y, \text{value}, \text{angle}$	$N^2 \times L_b \times M$
Volume data	$x, y, z, \text{value}$	$N^3 \times L_b$
Light-field	$x, y, \text{value}, \text{angle}_x, \text{angle}_y$	$N^2 \times L_b \times M^2$
Time-sequence	$x, y, \text{value}, t$	$N^2 \times L_b \times T_2$

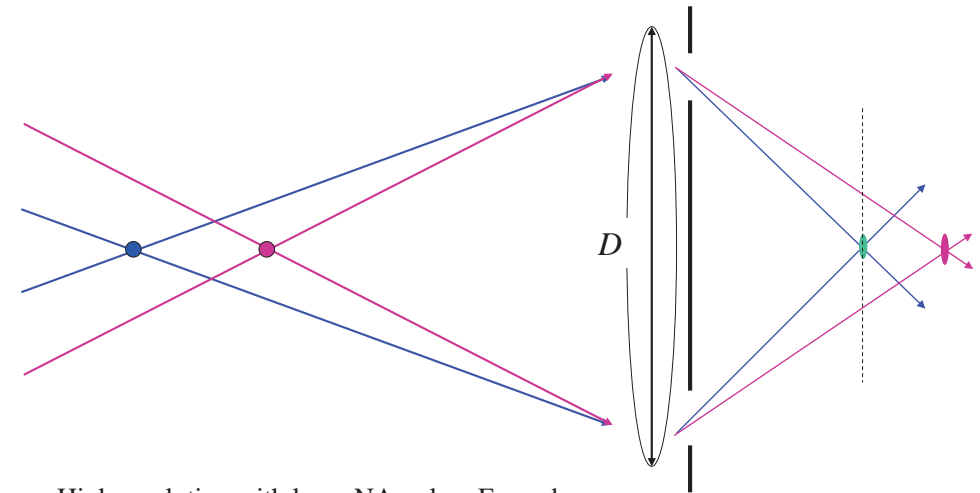


## 6.2 3D measurement techniques

Type	Principle	Technology	Example(s)
Passive	Monocular	Texture, shade	
	Disparity	Lens focus	Stereo matching
	Trigonometric	Stereo Motion parallax	focusing
	Projection	Projection	Computed tomography Confocal microscopy
Active	Disparity	Active stereo, Structured light illumination Moire	Laser projection slit, coded pattern, Fringe
	Photometric	Photometric stereo	Depth from shading
	Optical path measurement	Interference	Heterodyne Optical Coherence Tomography Phase difference Time of flight

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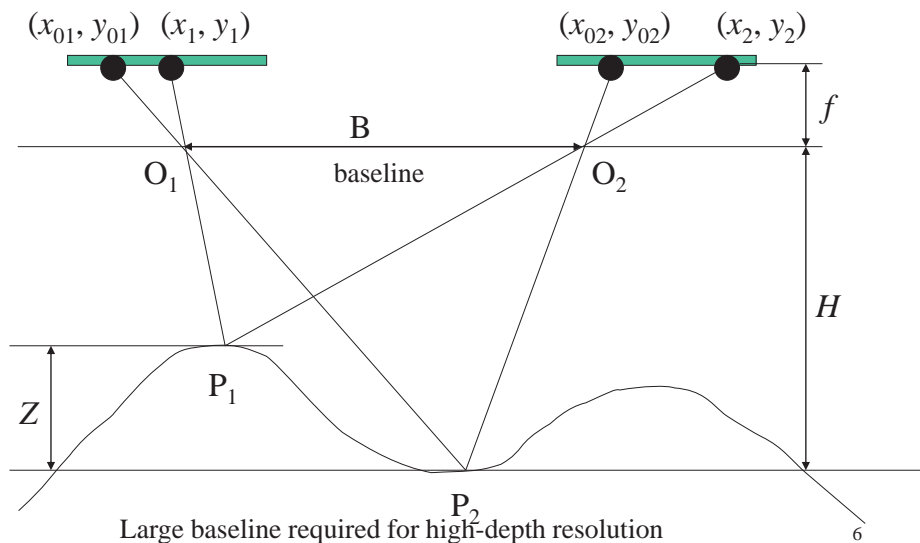
## Light-rays captured by a lens



High resolution with large NA or low F-number  
 $NA(\text{Numerical Aperture}) = n \sin \alpha$   
 $F\text{-number} = f/D$

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## Principle of trigonometry



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## 6.3 3D display techniques

	Principle	Method	Depth-cues (Only important cues shown)
No parallax Single 2D image	Monocular depth-cue	Pictorial techniques	Overlapping, Linear Perspective Texture Gradient, Shades and Shadows, Aerial Perspective
		Large field of view Floating real-image	Display surface becomes unstable
No parallax Multiple 2D images		Motion picture Observer Tracking	Motion Parallax
Binocular stereogram Two 2-D images	Binocular parallax	Polarizing glasses, Anaglyph, Time-sequential, Goggle, Lenticular stereogram (binocular)	Binocular Parallax
Autostereoscopic 3D display (3D images)	Multi-view	Parallax panoramagram Lenticular sheet IP, Integral imaging	Binocular Parallax, Motion Parallax
	Depth sampling	Varifocal mirror LCD Stack	Binocular Parallax, Motion Parallax Accommodation, Convergence Difficult to reproduce overlapping effect
	light-ray or wavefront reconstruction	IP, Parallax barrier, High-density light-ray reproduction Holography	Binocular Parallax, Motion Parallax Accommodation, Convergence

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