OLYMPUS
Your Vision, Our Future
Physics limited resolution of videoscopes
Pushing the limits of resolution and why optics know-how is now critical

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Feb 2, 2017
How does Olympus lead in the world of optics and videoscope resolution.

- Quick Olympus Overview
- Latest Olympus Resolution Innovations
- Basic Videoscope Structure
- The Challenges Faced by Inspection in Space
- Zero Gravity Scope (VAU)
- General needs of a small access camera like a videoscope
- Science affecting 6mm videoscope resolution
- What have we been able to accomplish
- Bringing it all together – Know How
Track Record of Innovation in Remote Visual Inspection

1949 – First Gastrocamera

1964 – First Gastrocamera With Fiberscope

1982 – First Medical Video And Ultrasound Endoscopes

1999 Eye-Trek

2002 – First High definition Videoscope system

2009 – First 3D Measurement Laser Microscope

2007 – First High Resolution Capsule endoscope

2001 IPLEX SA

2004 MX

2007 LT/LX/MXII

2009 UltraLite

2011 IPLEX RT/RX

2013
HD RVI Has Arrived

**iPLEX NX**

BIG SCREEN SURGERY
Get Closer with Full 4K

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Olympus constantly fine tunes the basics of Videoscope Structure, with small advances to make scopes more user friendly. Particularly short optical sections and maneuverable distal ends.
Challenges of Inspection in Space

• Components of all shapes and sizes
• Vacuum and pressurized applications
• Power is at a premium
• There is no higher cost of failure than in space travel or work.
Zero Gravity – VAU Project

- Olympus has worked with NASA on Projects to advance the limits of remote visual equipment
General needs of small access cameras like videoscopes

• Acquire an image that is not possible to see with the human eye on its own, often needs to make bends.

• Need to see as much of the area in front of the remote viewing device as possible, therefore have the entire view in focus and with ideal light and color.

• Better technology alone does not achieve these two key factors, but design and assembly skill maximize physics.
Main Components of a RVI

- Physics + Skill

Technology
Physics Challenges Acting Against Achieving a Good RVI

Diameter

Flexibility & Access Requirements

Portability

Durability
OPTICS - Monochromatic Optical Aberrations

- Spherical Aberration
- Astigmatism
- Distortion
OPTICS - Monochromatic Optical Aberrations

- Modulation Transfer Function (MTF) and Line Pair Capability
OPTICS - Chromatic Optical Aberrations

- Chromatic Aberrations Axial and Lateral
APERTURE – Affects of Aperture on image

• Light Availability and Dispersion
APERTURE – Affects of Aperture on image

- Diffraction and Airy Disc
APERTURE – Affects of Aperture on Image

- Depth of Field and Circle of Confusion

Large Aperture

Small Aperture
CHIP—Physics Considerations of Camera Chip

• Size of Chip
  – It must fit inside typically a 4mm or 6mm distal end, naturally if that isn’t a limitation, the CCD size and aperture size are also not limited.

• Size of Pixels
  – Pixel sizes from 1.9µm to 5.6µm are not uncommon. At this size, the resulting required optic system precision is critical. Based on this as pixel sizes approach 2.0 µm, diffraction patterns must be kept to 4-5 µm or they risk being diffraction limited.
Common Corrective Measures

• Lens Materials
  – Those able to use multiple materials to make lens system open many possibilities. To building lens systems.
  – Issue is it costs more and is more complex; including durability considerations
Common Corrective Measures

- Stopping Aperture

Makes it darker, not good for inspections.
Common Corrective Measures

- Offset Aperture

Longer distal end;
Often not acceptable for navigations/inspections
Common Corrective Measures

- Lens Systems

Best solution, but costly and requires greater assembly skill
Where are physics causing bottlenecks

• Micro-Optics Manufacturing

Greater chip density, makes even the smallest aberrations more obvious
Where are physics causing bottlenecks?

- Diffraction Limitation and Aperture Requirements

Higher density chip will not correct for diffraction limitation.
What does a good balance look like?
What have we been able to do?

- Achieve exceptionally bright light transmission in a power conscious method.
- Optimize resolution of the optical system and chip sized for 6mm while maintaining functional depth of fields for inspections.
- Keep short distal end package to allow best maneuverability possible.
- So why is Olympus here, and what can we provide to the efforts of in space inspection?
We Bring Know How

• With hold over 1374 endoscope patents in the US alone.
• This know how provides the most durable and reliable core mechanisms in the endoscopic world. Critical for anything going to space.
• We are constantly seeking methods to make our customers, their interests and patients to have the very best in outcome and reliability.
• Perhaps together with other technology leaders, we can work towards serving both NASA’s needs, and our customers.
Any Questions?

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