ILLUMINATING THE DARK
FOR DIAGNOSTICS

THE PARTNERSHIP THAT REDEFINES MICROSCOPY PERFORMANCE FOR LABS WORLDWIDE

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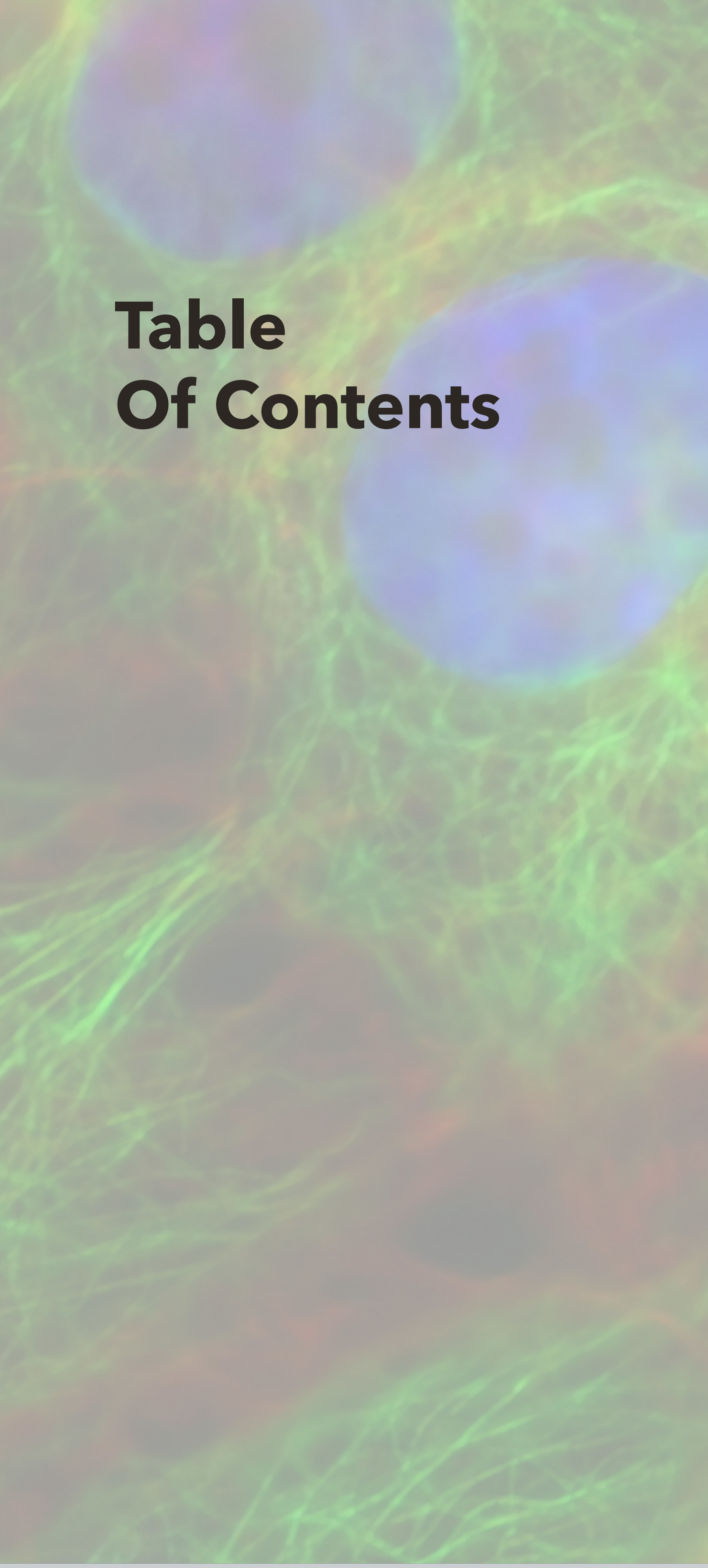


Table Of Contents

Getting Started

About the **Cover**

Light has the power to reveal what was once hidden. In advanced microscopy, it transforms invisible biological structures into clear, measurable insight—enabling researchers to accelerate discovery and improve diagnostic outcomes.

The cover symbolizes this journey from darkness to clarity. The microscope provides context, while the illuminated objective lens and fluorescent sample represent the precision optics that make high-resolution imaging possible. **Illuminating the Dark** for Diagnostics reflects the shared vision of Optikos and Novanta: advancing optical innovation that empowers the next generation of diagnostic and life science technologies.

Letter to the Next Pioneers in Medical Technologies

Knowing that we have just one life, we choose to focus our energy on making the time we've been given count, preferably for the benefit of everyone.

For the past seven years, I've had the privilege of speaking with individuals who have made it their mission to advance technologies that enhance human health and wellbeing. Through these conversations, I've witnessed firsthand how this ethos of betterment forms the foundation of every MedTech development. We're in the business of helping humanity—and that conviction runs deep through every innovation, every collaboration, and every breakthrough that reaches the market. From my vantage point on the optics side of the industry, I can tell you with certainty: our role in defining the next generation of biomedical breakthroughs is just beginning.

Optics are playing an increasingly vital part in transforming our field, which makes the collaboration between Optikos and Novanta not just logical, but inevitable. **Together, we've developed a revolutionary advancement in fluorescent imaging** that promises to redefine what is possible in medical visualization.

Since 2024, the formation of the Optikos Novanta partnership has transformed into something far more than a routine business transaction. In fact, we aspired to foster a convergence of two industry leaders united by a common purpose. Optikos brings decades of optical engineering expertise and precision measurement capabilities, while Novanta has built a legacy in advanced photonics and medical technology innovation. This partnership leverages our complementary strengths to push the boundaries of what fluorescent imaging systems can achieve in clinical and research settings.

We are dedicating the next pages to documenting what it takes to make such a partnership work. You'll discover the data behind the project, the challenges we've overcome, and the breakthrough innovations that form the backbone of **our latest two-channel fluorescence microscopy system.**

This isn't just technical documentation: It is a roadmap for how collaboration can accelerate the pace of medical discovery and translate engineering excellence into clinical impact.

For the pioneers reading this, the innovators, clinicians, and researchers pushing the frontiers of what's possible, this partnership signals a new step in achieving the accurate diagnoses and transformative discoveries that drive your mission forward. **We are launching a new stage for fluorescence in MedTech** where optical precision meets clinical need, where engineering excellence serves human wellbeing. In the end, we want to showcase how successful collaborations drive the changes that matter most.

Optikos and Novanta stand at a generational moment in the history of MedTech. We invite you to be part of what comes next.

Yours truly,

Byron Seabolt

Business Development Manager at Optikos and Lead of the Optikos and Novanta partnership.

Introduction

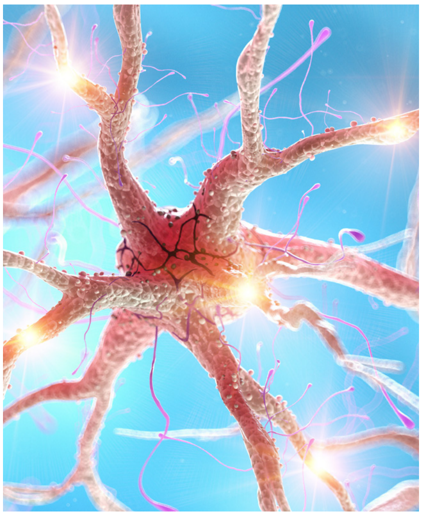
According to BCC Research, the global market for fluorescence microscopy is poised to increase from $968.5 million in 2024 to $1.3 billion over the next five years.[1]

Today's most powerful fluorescence microscope attains sub-5-nanometer localization accuracy in 3D throughout biological tissue across wide imaging regions of 10 x 15 micrometers.[2]

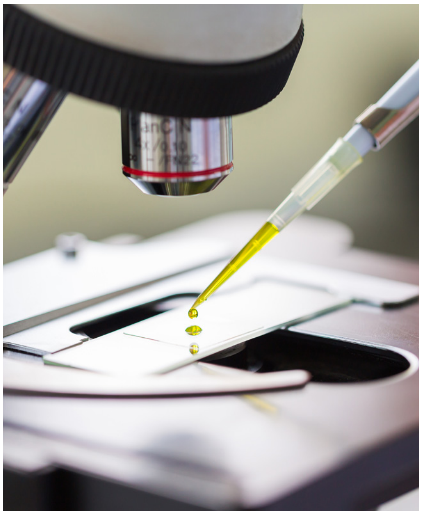
Recent breakthroughs powered by fluorescence microscopy include:

Revealing the Inner workings of cell structures[3]

Monitoring the activity of distinct neurons in brain tissue in vivo[4]



Understanding protein ubiquitination[5]



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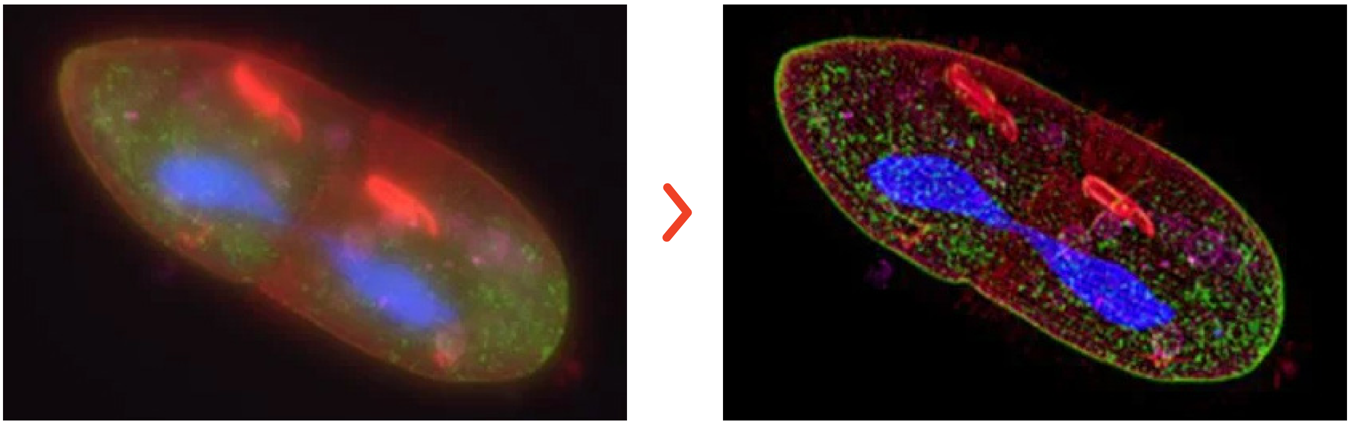


For more than a century, fluorescence microscopy has changed our understanding of cellular life forever. It transformed invisible molecular processes into vivid, quantifiable images that continue to drive breakthroughs in biology and medicine. We are getting closer to developing fluorescence imaging guided cancer therapies[6], figuring out how our brains work[7], and revolutionizing new drug discoveries.[8] All this is possible because fluorescence turns biological processes into light signals that we can capture, measure, and decode.

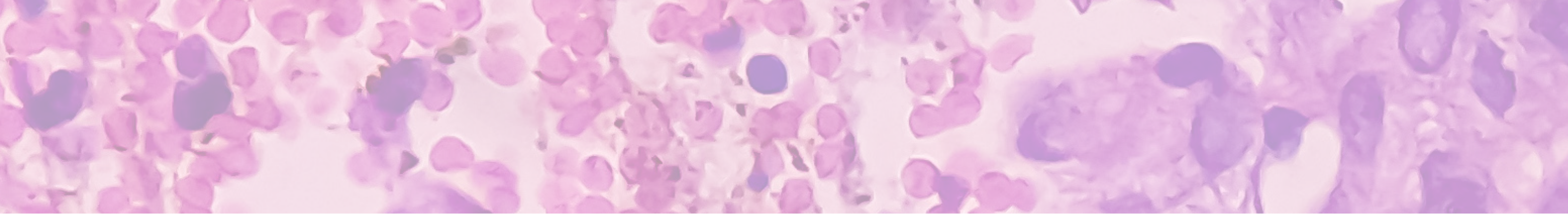
At its core, fluorescence microscopy performs two critical functions: **visualization** of molecular and cellular structures with heightened precision and **characterization** of dynamic biological processes in real time. This integration of high image resolution with process tracing allows us to quantitatively map matter and interactions.

Today, as artificial intelligence and quantum-enhanced imaging technologies push the boundaries of what's possible, the demands on optical performance have never been higher. From detecting subtle phenotypic changes to tracking single molecules and reconstructing AI-driven images, all of these advanced capabilities depend on one fundamental requirement: **uncompromising optical fidelity.** When diagnostic decisions, drug discovery timelines, and scientific conclusions rest on pixel-level accuracy, there is no room for optical aberrations, misalignment, or system-to-system variability.

The next generation of fluorescence platforms must deliver not just images, but **quantitatively reliable data,** where every photon that is captured accurately represents a biological truth.

This is the vision that drives the Optikos and Novanta partnership.

> “This is possible because fluorescence turns biological processes into light signals that we can capture, measure, and decode.”
>
> **Nathan Wallace,** *Director of Engineering Services at Optikos*



Behind the Names - Optikos®

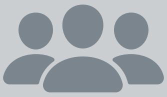
Lars Sandströem
Director of Business Strategy at Optikos

“How far do you get when you’re playing around with light? Optikos has been **pushing the boundaries** of this answer for the past **40+ years.**”

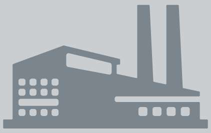
Optikos is the world’s largest independent optical engineering company. Based in Wakefield, MA, Optikos has developed its portfolio in three key areas: **engineering services, manufacturing, and metrology.** We drive precision and performance across markets such as space, defense, life sciences, automotive, semiconductor, consumer, and aerial imaging.

What sets Optikos apart is our ability to transform complex **optical concepts into manufacturable systems,** especially those others consider unsolvable. Drawing on over forty years of expertise spanning optics, optomechanics, electronics, and automation, we deliver end-to-end solutions that bridge the gap between ambitious visions and practical reality.

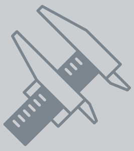
Optikos in Numbers:



90+
Employees



55,000+
Square feet of Production space



1
Ultra-specialized Metrology Laboratory

70+
Patents

Value Pillars:

Precision | Performance | Pioneering | Perseverance

KEY CAPABILITIES

Optical and Opto-mechanical Imaging System Design and Assembly

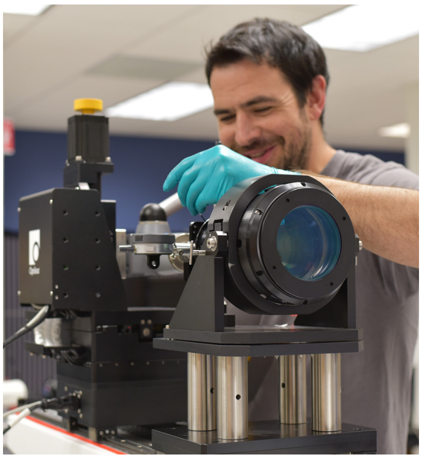
Achieves diffraction-limited performance, extracting the maximum theoretical resolution from every optical system.

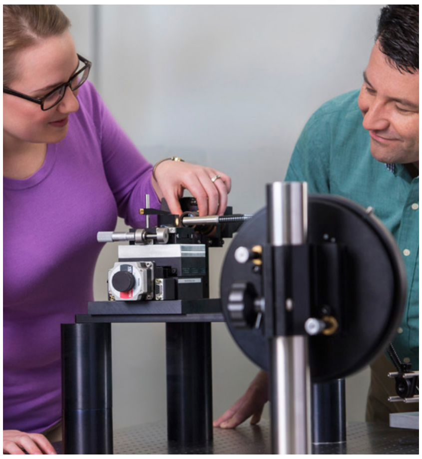
Precision Metrology and Wavefront Testing

Delivers quantitative validation at operational wavelengths, ensuring systems perform exactly as designed in real-world conditions.

Advanced Alignment Methodologies

Including Alignment Turning (AT) and precision alignment pucks that ensure manufacturing consistency and high yield at production scale, translating lab performance into reliable commercial systems.





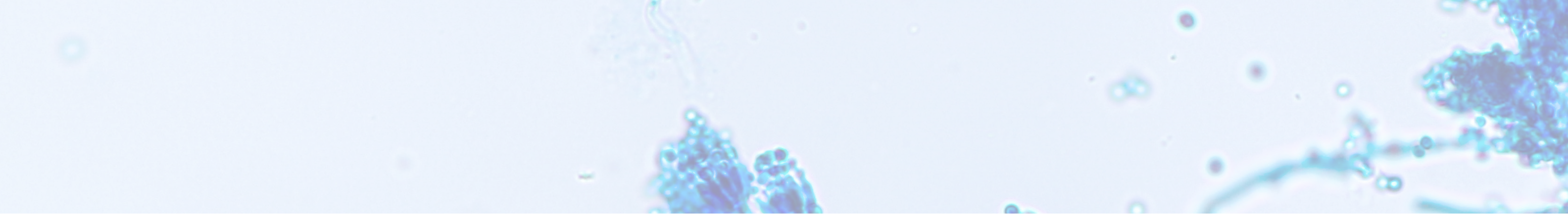
The Right Engineering Partner for Biotech Applications:

- **ISO-Certified Production**
  Your life sciences idea will be handled in ISO 9001:2015 and ISO 13485:2016 certified facilities with rigorous quality controls that ensure FDA and international medical device compliance from prototype to full-scale manufacturing.

- **Faster Time-to-Market**
  Optikos understands that speed matters. To help customers bring products to market quickly, the company offers pre engineered objectives and imaging systems including diffraction limited, apochromatic, and wide field fluorescence designs that lower costs and shorten development cycles.

- **Rigorous Performance Validation**
  Optikos uses stray light modeling, non-sequential ray tracing (Zemax/FRED/LightTools), Monte Carlo tolerance analysis, and opto-mechanical simulations to guarantee real-world system performance.

- **Deep Domain Experience**
  Customers and partners can trust in the extensive design and manufacturing expertise at Optikos across fluorescence imaging, gene sequencing, qPCR, OCT, endoscopy, spectrometry, and molecular sensing platforms.



Behind the Names - Novanta®

Andrew Carson
Senior Director, Engineered Systems at Novanta

"Complex optical instruments must be designed and validated as fully integrated electromechanical-photonic systems, where illumination, detection, motion, and control function as one coupled system. Only through unified design, fabrication, and system-level testing can they achieve the stability, coherence, and quantitative precision required for modern imaging and measurement applications."

Novanta

Novanta is a globally recognized technology partner for leading medical device and advanced manufacturing OEMs. For more than five decades, it has served as a sole source supplier, boosting productivity with precision motion, laser, and vision based solutions. Its deep in house expertise spans diagnostic instrumentation, photonics, embedded imaging, and precision motion systems, empowering the creation of robust solutions for the most complex and demanding applications.

Novanta's primary differentiator lies in a holistic systems engineering approach, treating each product as an integrated component within a broader technological ecosystem. This methodology results in embedded technical solutions designed for seamless integration into sophisticated operational processes. This strategy ensures every innovation enhances performance, reliability, and efficiency for customers across global markets.

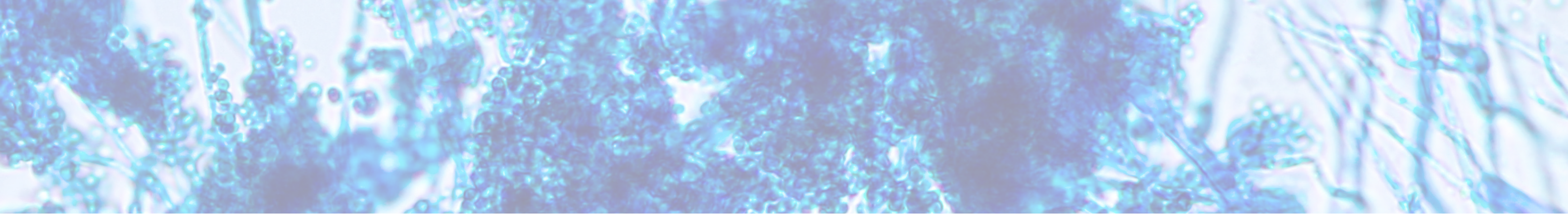
Novanta in Numbers:

20
Facilities Around The Globe

3,000
Employees

700
Engineers

600+
Patents



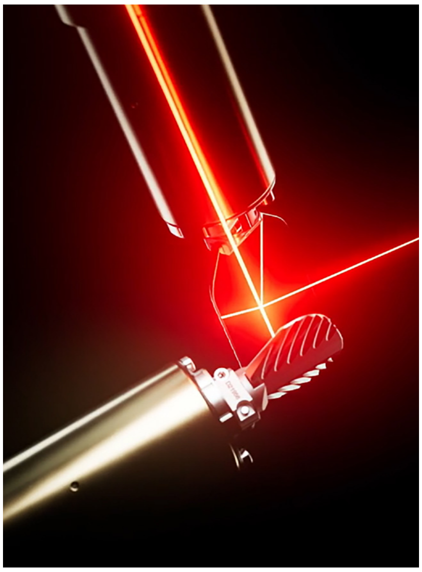
Value Pillars:

Performance Leadership | System-Level Solutions | Scaled Innovation | Engineer-to-Engineer Partnerships

KEY CAPABILITIES

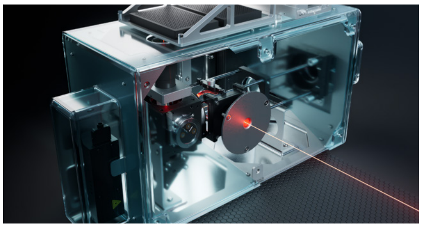
Laser and Beam Steering

Delivering world-class laser sources such as CO^2, DPSS, diode, ultrafast, combined with high-fidelity beam steering that powers integrated light engines for fluorescence and excitation systems.



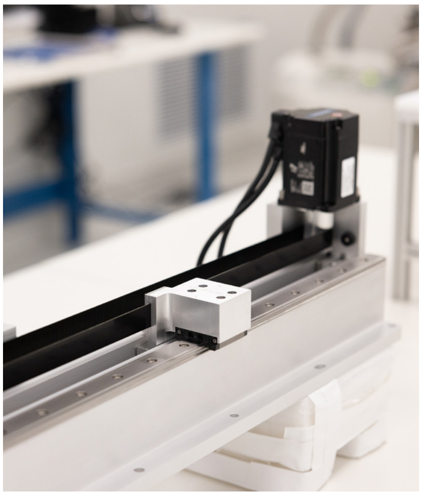
Light Engine Integration

Novanta's Modular Light Engine platform takes a system-first approach to illumination, using technology agnostic building blocks across the UV–VIS–NIR range to mix DPSS and diode sources into application optimized engines. Integrated optical features such as fiber coupling, beam shaping, despeckling, stabilization, and highspeed modulation/AOM to enable rapid turnaround, semiautomated, repeatable quality, and scaling of wavelengths and power. The result is at-sample performance that balances beam quality, intensity uniformity, and cost with demonstrated spectral stability over time and temperature (without active stabilization), while cross platform design learnings transfer efficiently across product lines to accelerate customer integration.



Positioning Solutions

Recognized as a fundamental capability of Novanta, the company develops ultra-reliable positioning systems, servo drives, encoders, and stages. These components serve as essential elements for sample handling and optical alignment in diagnostic systems, ensuring precise and timely movement within critical applications.



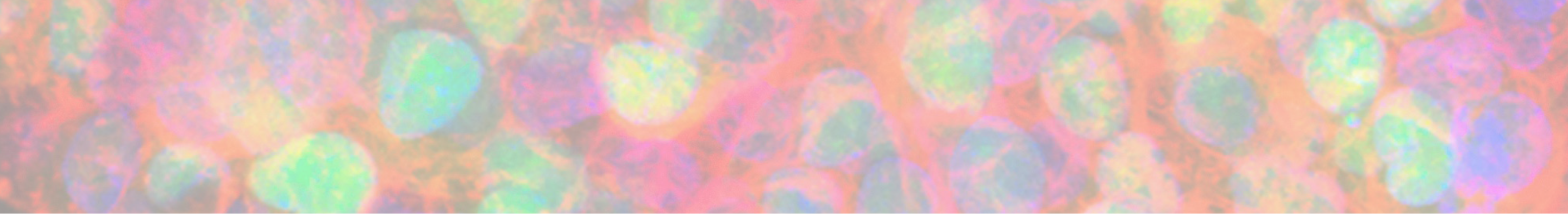
The Right Engineering Partner for Biotech Applications

- ☑ **Deep Application Expertise**
  Over five decades of specialized experience in diagnostic instrumentation, surgical robotics, and medical imaging gives Novanta the advantage of understanding the unique challenges of MedTech and speak your technical language.

- ☑ **Comprehensive Medical Technology Portfolio under One Roof**
  Access to a wide range of best-in-class capabilities including precision motion systems, laser sources, beam steering, and vision technologies, available from a single trusted partner. This integrated approach streamlines operations and eliminates the complexity that is traditionally associated with managing multiple vendors.

- ☑ **True System-Level Integration**
  Novanta delivers more than just components. The organization provides embedded solutions that are engineered for seamless integration into existing technology stacks, firmware, and workflows. This focus significantly reduces development time and technical risk.

- ☑ **Global Scale with Localized Support**
  With 3,000 team members across five continents, Novanta offers world-class engineering resources, robust supply chains, and responsive support ensuring operational excellence regardless of location.



The Partnership

Barry R. Masters
MIT in The Development of Fluorescence Microscopy

“There is a strong and active synergy between the life sciences and new developments in fluorescence microscopy.”

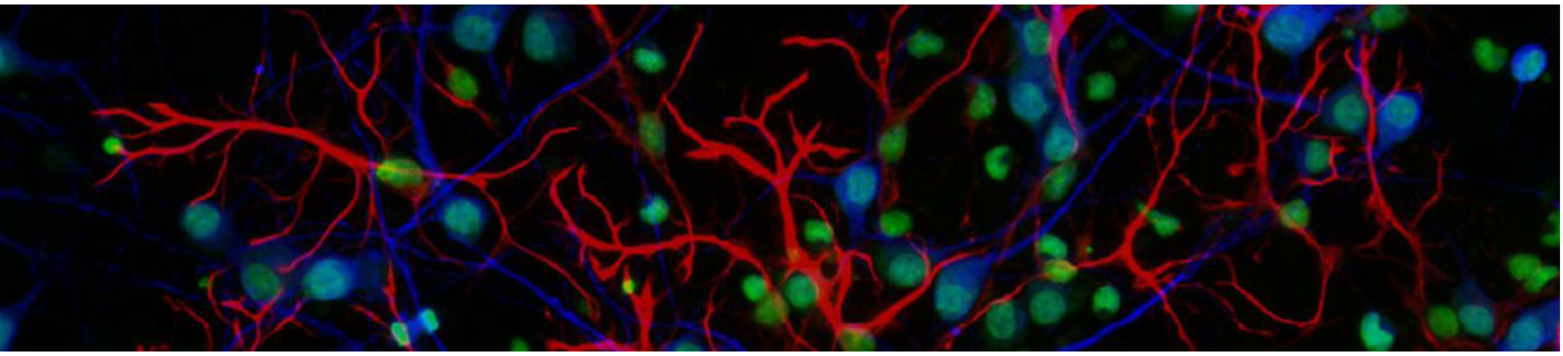
Microscopy Platform Overview

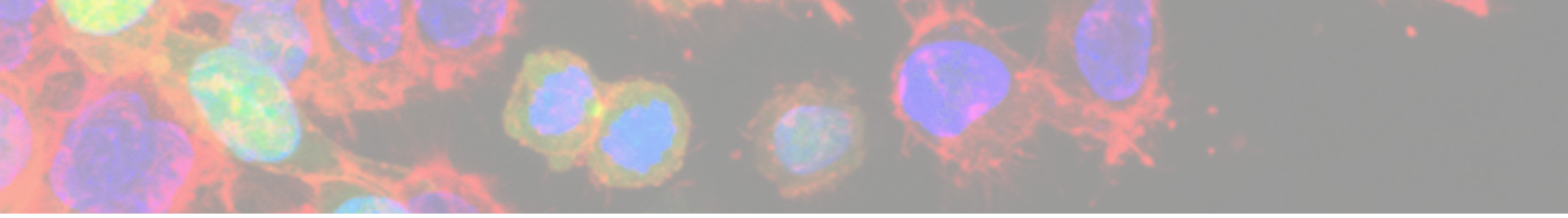
Novanta’s new scanning fluorescence microscope platform unites its core technologies—precision motion, illumination, sensing, controls, and software—into a single, reusable system architecture. Designing it as a platform rather than a one-off instrument enables early performance validation, speeds proof of concept builds, and creates a smooth transition from prototype to Alpha/Beta pilots. This modular approach ultimately leads to consistent and viable commercial programs with versatile industry applications. Other benefits include reducing development risk, shortening time to market, and allowing rapid customization for a wide range of diagnostic applications.

The result is a scalable foundation that can evolve with emerging needs, delivering consistent performance while protecting investment across multiple product generations.

Why Optikos® Is the Ideal Partner

It was clear from the beginning that Optikos would become the natural choice for the imaging optics partner for Novanta because the project demanded a holistic, hardware ready optical solution—not just a stand alone lens. From the outset, the objective and relay optics shaped the entire performance envelope of the platform, dictating everything from the mechanical layout and illumination strategy to the camera selection and control loops. Leveraging its deep expertise in integrated imaging optics, Optikos delivered designs that were not only high performing but also ready for manufacturing and rigorous testing. Their collaborative engineering approach meant that design reviews with Novanta turned into dynamic workshops, where optics, mechanics, and interfaces converged quickly and seamlessly. Backed by a proven production pipeline, Optikos charted a clear path that carried the optics from early prototypes to scalable, cost effective production, serving as an engineering partner for Novanta that mitigates risk while keeping the system flexible for future growth.





How It Happened:

The Optikos and Novanta Partnership Timeline

MID 2023

Partner Identification & Early Engagement
(By mid-2023)

Optikos was chosen early on as the strategic imaging-optics partner. Bringing Optikos in at this stage helped shape the overall system design and lowered the risk of costly integration issues later.

LATE 2024

Defining Requirements & Optical Architecture
(Late 2024 – early 2025)

The team defined the proof-of-concept (POC) optical specifications while simultaneously working on motion, illumination, and control subsystems, ensuring all parts fit together from the start.

Q1 - Q2 2025

Joint Design Reviews & Interface Alignment
(Q1 – Q2 2025)

Formal, collaborative reviews were held to synchronize optical performance goals, mechanical connections, and the overall project schedule.

MID 2025

POC Optical Specification Freeze
(Mid-2025, projected)

A firm lock on the optical specifications was achieved, allowing the ordering of components and moving the system build forward without further design changes.

Q2 - Q3 2025

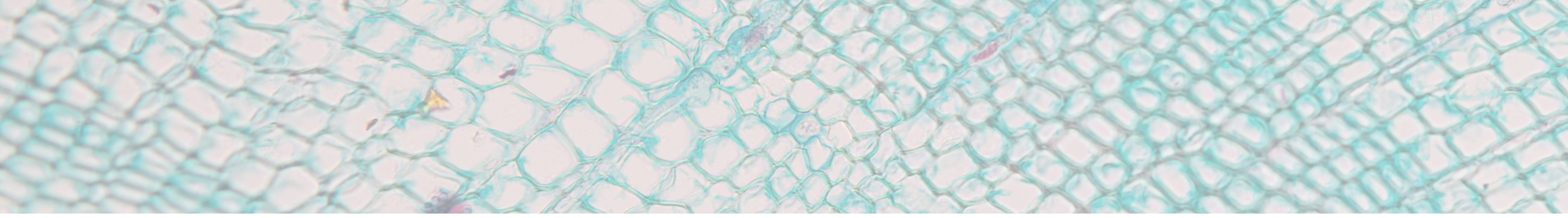
Manufacturing, Delivery & Testing
(Mid-2025 – September 2025)

Optikos produced, shipped, and validated the imaging optics, confirming they could meet performance targets and can be manufactured reliably.

Q3 2025

System Integration & Bring-Up
(Q3 2025 – present)

The finalized optics were integrated into the platform's POC system, and end-to-end performance testing began to ensure the complete solution worked as intended.



Introducing a New Standard in Co-Designed Fluorescence Imaging

Distinguishing a game changing fluorescence microscope from a merely adequate one hinges on a deep understanding of researcher requirements and the translation of those needs into a rigorous product design. In this regard, the market is clear on three non-negotiables in this direction:

1. Sensitivity and Signal-to-Noise Ratio

Researchers want to detect weak fluorescent signals originating from small structures or low-abundance molecules, all while minimizing background noise. Achieving this requires high-performance detectors such as cameras with low read noise, efficient light collection optics, and optical components with minimal autofluorescence. The capacity to image dim samples without photobleaching or phototoxicity is essential for advanced biological studies.

2. Resolution, Both Spatial and Temporal

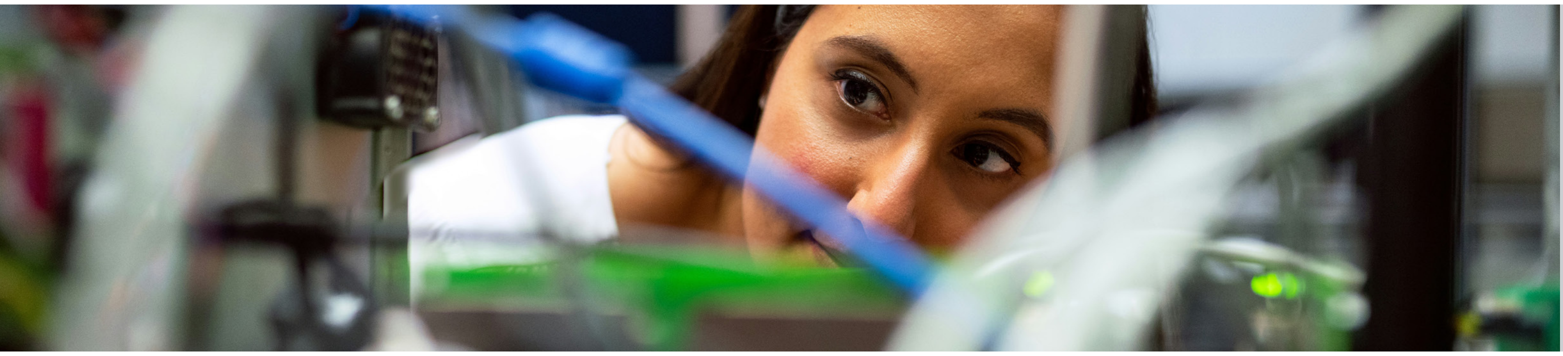
End users of fluorescence microscopy routinely analyze fine cellular structures and fast dynamic processes, imposing dual demands for spatial and temporal resolution. Optimal spatial resolution enables the distinction of closely spaced features within cells, commonly enhanced through super-resolution techniques and high numerical aperture (NA) objectives. Concurrently, high temporal resolution and rapid acquisition speeds facilitate the observation of dynamic biological events as they unfold in real time. This includes processes like calcium signaling, vesicle trafficking, and protein dynamics. Together, these capabilities are critical for the successful visualization and quantification subcellular phenomena.

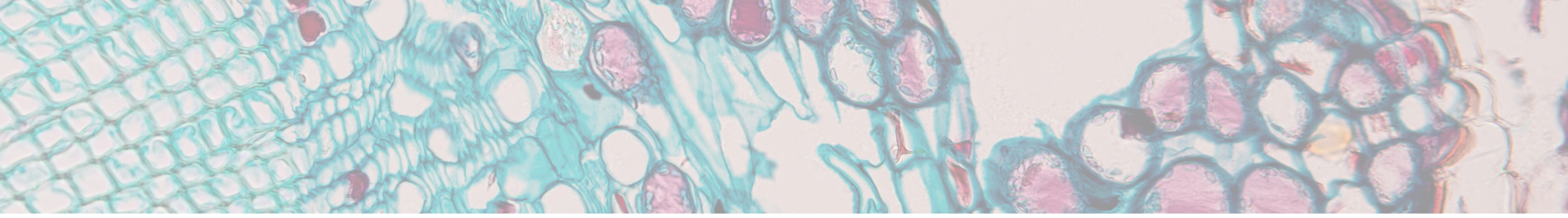
3. Photostability and Sample Viability

For live-cell imaging especially, fluorescence microscopy systems must balance the minimization of photodamage with the preservation of image quality. Reducing excitation light exposure is achieved through advanced illumination strategies such as spinning disk confocal microscopy or light sheet microscopy, which illuminate targeted regions and thereby significantly decrease phototoxicity compared to traditional widefield methods. Additionally, minimizing photobleaching is essential to enable extended time-lapse studies, ensuring sustained signal integrity and the biological relevance of long-term observations.

These constraints, combined with inherent optical and optomechanical challenges, underscore the complexity of developing a truly versatile imaging system for microscope-based applications. In response, Optikos designed a modular platform that may be tailored to specific research requirements or deployed as a turnkey solution for immediate testing and experimentation, an approach that serves both emerging diagnostic enterprises and established research laboratories.

The Optikos development philosophy centers on precision-driven innovation, methodically addressing the most challenging technical requirements in the field.

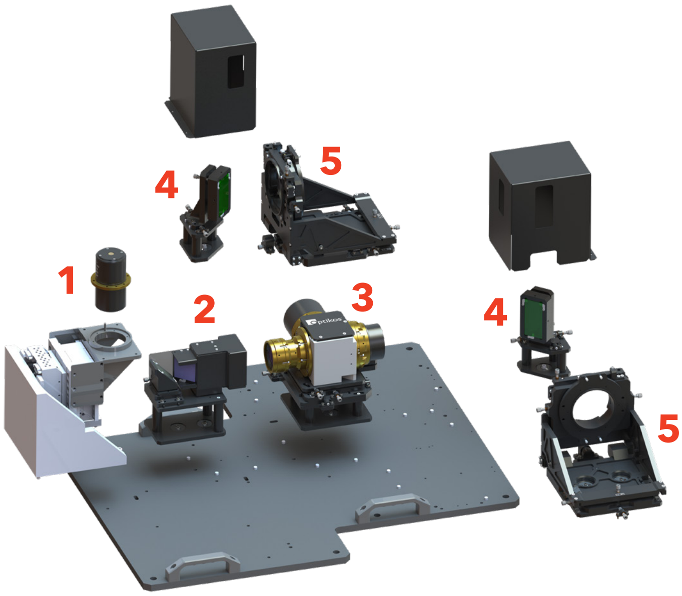




A Dual-Channel Platform for Modern Fluorescence Microscopy

The new fluorescence microscopy imaging system is made of:

- **The Objective** 1
- **The Filter Block** 2
- **The Tube Lens** 3
- **The Camera Folds** 4
- **The Camera Mounts** 5



Fast-Tracking Excellence Through All Quality Steps

The development of a high-performance and cost-effective fluorescence microscopy system required a comprehensive re-evaluation of conventional approaches at every level—from the characterization and fabrication of individual optical components to the validation and commercialization of complete assemblies. Rejecting the traditional trade-offs among performance, manufacturability, and cost, **Optikos implemented an integrated strategy where optical design, precision machining, and metrology function as interdependent elements within a unified system.** The result is a dual-channel prototype that leverages advanced manufacturing processes to deliver research-grade imaging performance, while maintaining the modularity and accessibility required by emerging diagnostic companies and research-focused organizations. The following sections outline the principal technical innovations realized in optical design, mechanical fabrication methods, and quality assurance.

> “Optikos implemented an integrated strategy where optical design, precision machining, and metrology function as interdependent elements within a unified system.”
>
> **Lars Sandströem,** *Director of Business Strategy at Optikos*

Optical Innovation Starts with Fab-Fit for Smart Manufacturing

What Is Fab-Fit?

Think of fab-fit like a tailor taking your measurements before making a suit, but for optical components. We measure each lens as it is manufactured and then redesign the system around those specific pieces, to ensure seamless, optimized integration.

How It Works:

When it comes to lens making, we obtain measurements of three critical parameters:

01. The exact glass composition (refractive index and dispersion properties).

02. The precise surface curvatures.

03. The actual center thickness.

Instead of these being sources of error, they become data points we use to our advantage.

Why We Choose This Process:

Normally, glass from different production batches (called "melts") can vary enough to degrade image quality. By getting the measured properties of the actual glass used, uncertainty is reduced to that of the measurement.

The design is then reoptimized by adjusting the air spaces between lenses, these become our "tuning knobs." Each system has slightly different spacing, perfectly calibrating it to the lenses it contains.

THE PAYOFF IS THREEFOLD:

Better Performance

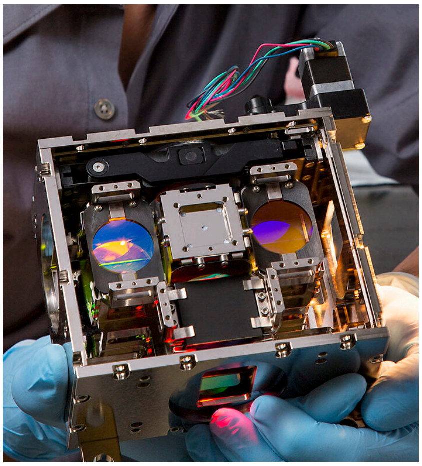
Tighter tolerances become achievable in the design (using measurement uncertainty instead of manufacturing variability), resulting in better, more consistent image quality across all systems.

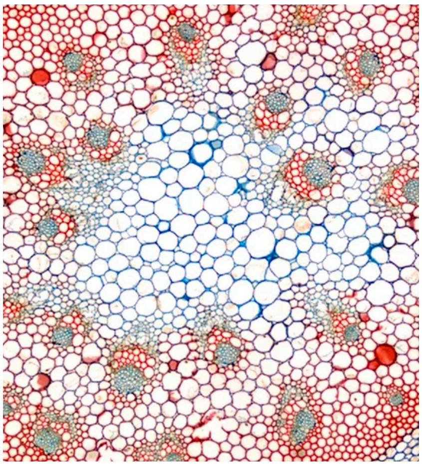
Higher Yield

More systems meet our stringent performance requirements because we are working with real parameters rather than circumventing them.

Lower Cost

We can work with lenses that have looser manufacturing tolerances because we can measure and compensate for variations. Looser tolerances mean more cost-effective optics.





Mechanical Innovation Is Achieved through Alignment Turning (AT)

The Marriage of Optics and Mechanics

Fab-fit tells us each system needs slightly different air spaces between lenses. Alignment turning is how to achieve this with precision time after time.

The Traditional Problem:

In conventional systems, the mechanical lens holders (cells) need extremely tight tolerances. If a cell's outer diameter is off by even 10 micrometers (less than the thickness of a human hair), the lens inside will be decentered, degrading image quality. Custom-machining each cell to these tolerances is often expensive and time-consuming.

Our Solution:

We buy standard lens cells with relaxed tolerances, then machine them in-house using alignment turning to match the specific requirements of each system. This process includes several advantages:

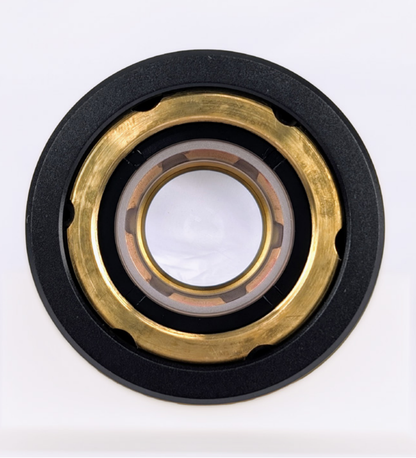
CONTROLLING THREE CRITICAL PARAMETERS:

Element Decenter

By precisely machining the outer diameter of each cell, we control exactly where each lens sits relative to the optical axis. Imagine trying to stack coins perfectly centered on top of each other—AT gives us the precision to do this reliably, every time we need it to.

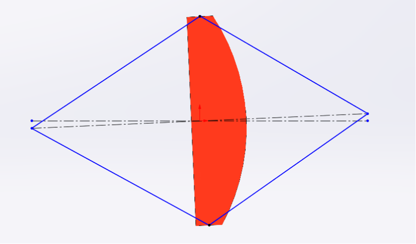
Airspace Control

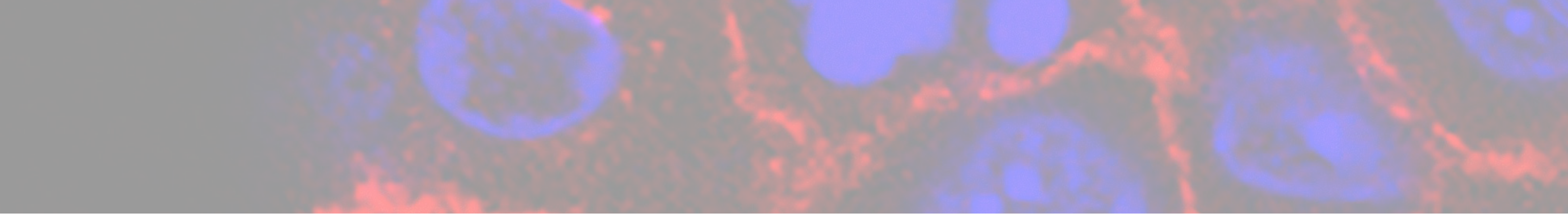
By machining the edge thickness of each cell, we set the exact air gap needed (as determined by fab-fit). It's like having adjustable spacers that are permanently set to the perfect length for each system.



Wedge Compensation

Most lenses aren't perfectly symmetric—one side might be slightly thicker than the other, creating a "wedge." Alignment Turning lets us machine the cell, rather than rolling and pushing the lens, to align the cell's mechanical axis (the center axis of the cell) to the optical axis (the line connecting the centers of curvature of each surface) of the lens. By compensating for wedge errors this way, looser wedge tolerances can be specified when ordering lenses while achieving much better alignment in the final system. Better performance is now achievable with more budget-friendly options.

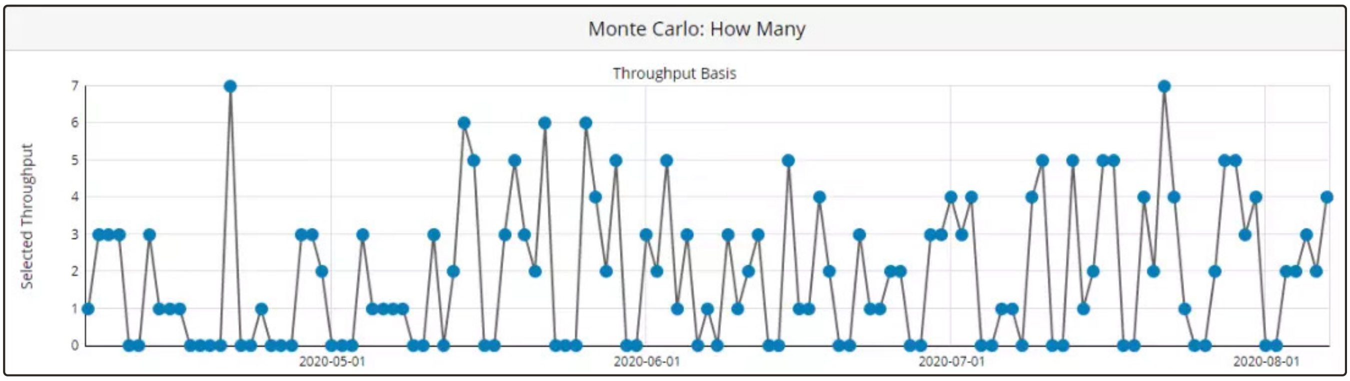




The V-Block Assembly Advantage

Because all our lens cells have nearly identical, precisely controlled outer diameters, we can use a simple V-block fixture during assembly. Picture a precision-machined groove that cradles each cell perfectly. Specialists quickly stack the objective elements, make minor adjustments to the compensator positions, and verify performance—all without elaborate alignment procedures.

This is "Design for Manufacturing" in action: the initial investment in AT capability pays dividends in faster, more reliable assembly with higher yields.



Validating the Approach through Multi-Step Monte Carlo Analysis: Simulating It Before Building It

Monte Carlo analysis isn't unique to us, but our multi-step approach mirrors our actual manufacturing process, making it a powerful predictive tool.

WHAT WE SIMULATE:

Manufacturing Variability

Random variations in all optical parameters, as they would occur in real production.

Measurement and Re-optimization

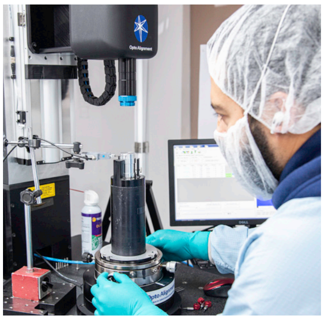
Receiving simulated melt data, radii, and thickness measurements, then reoptimizing the design (just as we do in fab-fit).

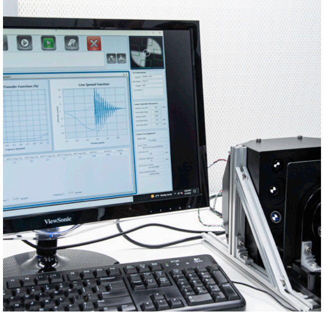
Alignment Turning Capabilities

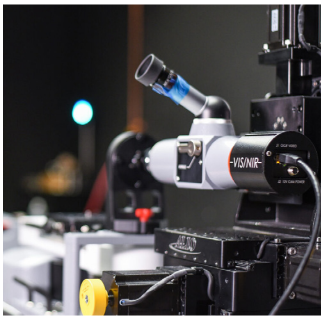
The precision we can actually achieve with our AT process.

Assembly Process

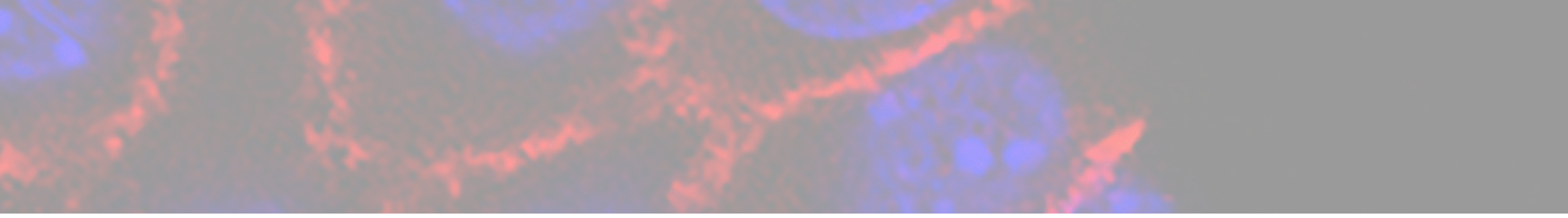
The build sequence and achievable tolerances.







By running hundreds of these simulations, we can predict the performance distribution of our production systems. This lets us design with confidence, knowing our yield rates before we cut the first piece of metal.



The Tube Lens Block through Passive Alignment Innovation

The Challenge of Multi-Color Imaging

Fluorescence microscopy typically requires imaging multiple wavelengths (colors) simultaneously or in quick succession. Traditionally, this means having separate tube lenses for each imaging path, with dichroic beam splitters directing different wavelengths to different cameras. This approach is bulky, expensive, and alignment-intensive.

Our Solution: The "1.5 Tube Lens" Architecture

We have developed a proprietary passively-aligned tube lens block that incorporates:

- **A partial tube lens before the dichroic beam splitter;**
- **The dichroic beam splitter positioned in nearly collimated (parallel) light;**
- **A second partial tube lens after the beam splitter.**

Why This Matters:

Designing for a “1.5 Tube Lens” architecture has two major advantages:

01

COST SAVINGS:

Such a design requires less total glass, specifically 1.5 tube lenses instead of 2 full ones;

02

BETTER, MORE PRECISE PERFORMANCE:

Dichroic beam splitters perform best when light hits them at consistent angles; the designed collimated space provides this opportunity.

The passive alignment design means the internal components are positioned during manufacturing and don't require field adjustment, an impactful design improvement for current fluorescence imaging systems. This approach shifts from a "tune-as-you-go" model to a precision-built system designed for stable, repeatable performance.

Modularity Potential

In the current development stage of the imaging system prototype, our team of experts is exploring whether these blocks can be truly modular. One approach we are testing includes swapping different dichroic beam splitters for different fluorophores by simply exchanging the entire block. This thought process is like having interchangeable camera lenses in the system rather than buying a new camera for each type of imagery. We are currently validating the consistency and repeatability of the dual-channel imaging subsystem's performance with this approach.

The Filter Block: Integrated Illumination and Detection

Consolidating Critical Components

Our filter block houses three essential optical elements in a single kinematically mounted unit:

Illumination Dichroic

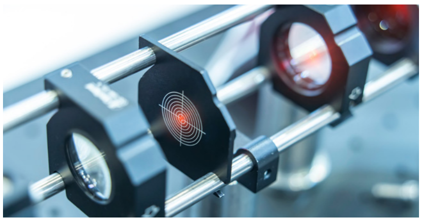
Directs excitation light to the sample

Autofocus Dichroic

Enables continuous focus tracking

Cleanup Filter

Blocks unwanted wavelengths from reaching the detector



Kinematic mounting

The block contacts its mount at exactly three points (or three regions), making its position highly repeatable. Removed and reinstalled to the same position every time.

The Modularity Vision

Similar to the tube lens block, filter blocks are tested to see if they can be swapped to quickly change the system's spectral capabilities. Consider switching from imaging green and red fluorophores to blue and yellow in the time it takes to swap a filter wheel, with performance all the critical elements are now possible because they are pre-aligned in their block.

The Challenge:

Filter thickness should to be well-controlled because it affects the optical path length. Our engineers at Optikos are determining the required tolerances need to be to maintain modularity without sacrificing performance within this first prototype.

Low-Stress Optical Mounting Is the Key

The Problem with Conventional Mounts

When a flat optical element like a filter or mirror is clamped too tightly or unevenly, it will distort the optic. Even tiny distortions, create wavefront errors that degrade image quality. Especially in high performing environments like fluorescence microscopy, there is no room for such errors.

Our Approach: Three-Pad Mounting

Optikos uses a three-pad mounting scheme that minimizes stress on filters and fold mirrors. By contacting the optic at just three carefully positioned points and controlling the clamping force, we ensure the element stays flat and undistorted.

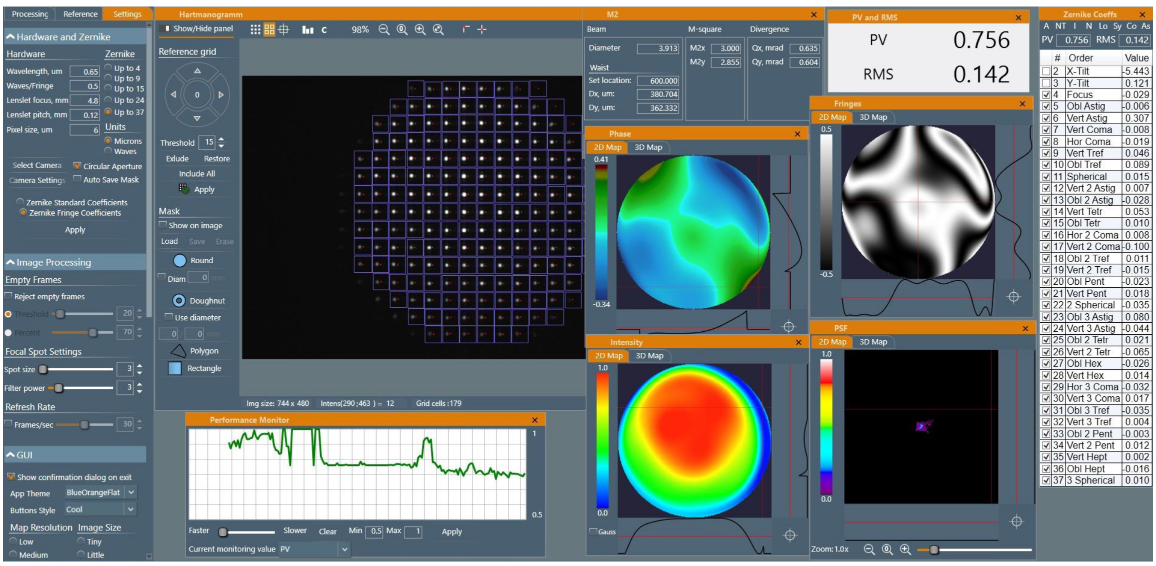
The Result

The wavefront error is driven by manufacturing precision, not by how the elements are mounted ensuring no additional errors are introduced during assembly.

Trusting Metrology by Measuring What Matters

Shack-Hartmann Wavefront Sensor

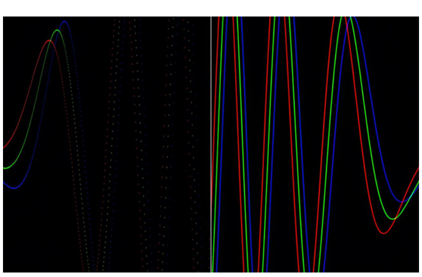
Traditional interferometers (like Fizeau interferometers) are powerful but inflexible—they're essentially precision instruments that must remain in a control lab environment to function reliably.



Our Wavefront Sensor Approach Offers Key Advantages:

Wavelength Flexibility

Optikos can test at the wavelengths used during operation, not just the 633 nm helium-neon laser line that most Fizeau interferometers use. This matters because optical performance varies with wavelength. Testing at 633 nm doesn't indicate how the system performs at 488 nm (when researching Green Fluorescent Proteins for neuroscience) or 750 nm (when looking for PD-L1 and PD-1 checkpoint proteins in tumors).

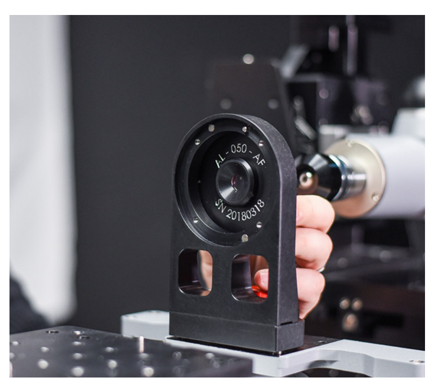


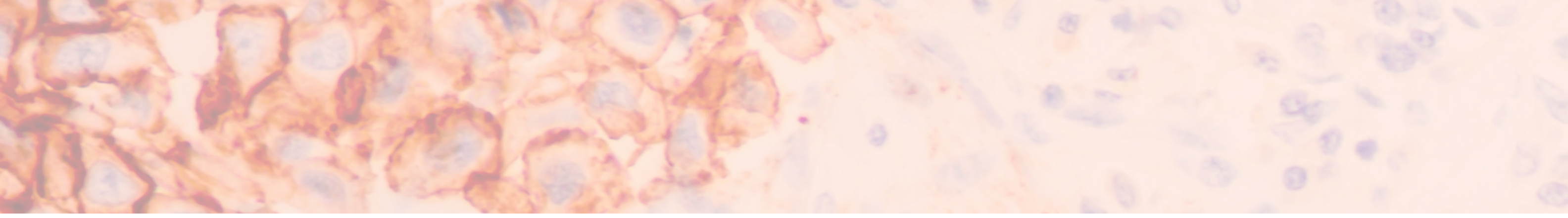
Portability

Optikos can bring the wavefront sensor to the system instead of bringing the system to the lab. This allows us to design test fixtures that integrate directly with the imaging system, making testing faster and more representative of real operating conditions.

Off-Axis Testing

Optikos offers testing to the edge of the field of view? With a Fizeau, you'd need to mechanically move the entire system. With our Shack-Hartmann sensor, we move the reference sphere and sensor, which is much simpler and faster.





Alignment Pucks and Targets Translate into Mechanical Precision

Alignment turning enables a further innovation within the Optikos assembly process.

The Concept:

Optikos produces precision target pucks utilizing the same diamond-turning process used for lens cells. Each puck incorporated the following:

- **A reticle or alignment target that is centered and perpendicular to the cell, defining the optical axis; mounting flanges held to extremely tight tolerances relative to the alignment target;**
- **Interfaces that precisely match the mounting locations for the objective, tube lens, or camera.**

The Process:

During assembly, Optikos employs these pucks as proxies for the actual optical elements. This approach enables the use of an alignment telescope and autocollimator to bring all alignment targets into precise collinearity along a common optical axis. The glass reticle provides a reference surface for optical alignment. Mechanical mounts are adjusted to establish the necessary spatial relationships within the system, as indicated by the pucks. Upon verification that the mechanical framework is properly aligned, the pucks are removed and the optical elements are installed. Because the pucks utilize the same mounting datums as the final components, aligning the pucks inherently aligns the mechanical system. As a result, the optics are positioned near nominal locations, requiring only minimal final adjustments to achieve optimal system performance.

Why This Approach Works:

Alignment-turned pucks employing the same mounting datums (reference surfaces) as the actual components ensure that the alignment targets establish an optical axis coincident with that of the lens elements. As a result, aligning the pucks inherently aligns the mechanical system itself. Upon installation of the final optics, their positions are already near nominal, requiring only minimal final adjustments to achieve optimal system performance.

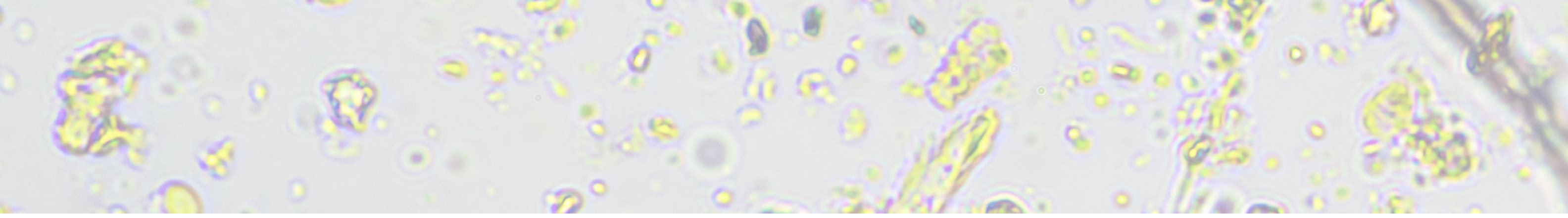
The Complete System: Greater Than the Sum of Its Parts

These innovations work together synergistically:

Traditional interferometers (like Fizeau interferometers) are powerful but inflexible—they're essentially precision instruments that must remain in a control lab environment to function reliably.

01	**FAB-FIT**	Determines spacing needed between elements.
02	**ALIGNMENT TURNING**	Achieves precise spacing precisely while controlling decenter and wedge.
03	**MONTE CARLO ANALYSIS**	Validates our approach will yield consistent, high-performance systems.
04	**THE TUBE LENS BLOCK**	Simplifies assembly while enabling multi-color imaging.
05	**THE FILTER BLOCK**	Consolidates critical components for modularity.
06	**IMPROVED MOUNTING**	Promotes repeatable performance during assembly.
07	**SHACK-HARTMANN METROLOGY**	Verifies system performance at relevant wavelengths.
08	**ALIGNMENT PUCKS**	Streamline the mechanical alignment process.

The result is a fluorescence imaging system that delivers exceptional, consistent performance at a lower cost than conventional approaches. Through the Optikos-Novanta partnership, we bridge precision engineering and scalable manufacturing, delivering superior image quality without the cost typically associated with high-end instrumentation.



What We Used to Build the Dual Channel Fluorescence Subsystem

This fluorescent imaging system combines ultra-precise alignment machines, advanced opticalaxis stations, wavefront metrology, and interferometric testing to guarantee diffraction limited performance and rigorous quality assurance at every stage. Because every component is engineered and verified for high-performance operation, end-users receive consistently reliable, crystal-clear images that accelerate discovery and drive confidence in results.

Precision Alignment and Manufacturing Systems

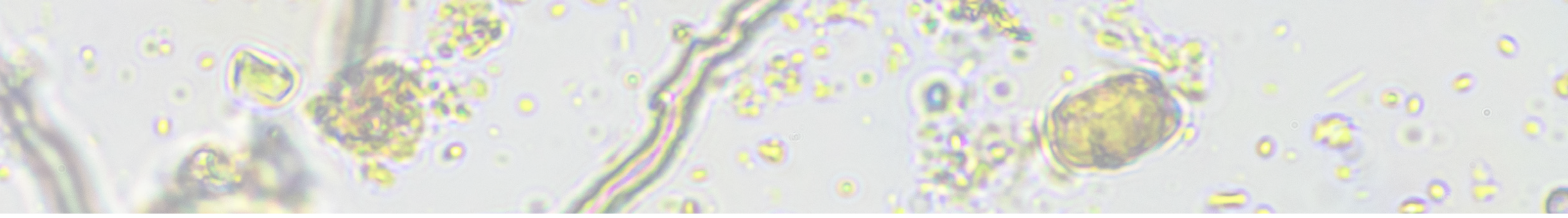
Alignment Turning Machine

- Machines lens cells, alignment targets, and interface plates with sub-micron precision;
- Enables active alignment during fabrication for consistent optical axis registration across all components.

Optical Alignment Station

Consisting of Alignment Telescope and Autocollimator

- Establishes and measures the optical axis of the objective target (decenter and tip/tilt);
- Transfers optical axis reference through the system to align tube lens and camera mounts;
- Ensures all optical elements share a common optical axis for diffraction-limited performance.



Wavefront Metrology Systems

System-Level Wavefront Sensor

- Measures the complete wavefront of the fully assembled optical subsystem;
- Validates end-to-end optical performance at operational wavelengths;
- Quantifies aberrations and confirms diffraction-limited image quality.

Interferometric Testing System

- Measures reflected wavefront error of mirrors;
- Measures transmitted and reflected wavefront error of optical filters;
- Verifies components meet specification prior to assembly;
- Confirms mounting procedures induce minimal stress and wavefront distortion into optical elements.

Quality Assurance Protocol

This equipment suite enables:

- Component-level validation before assembly;
- Active alignment during integration;
- System-level performance verification;
- Quantitative confirmation of optical specifications.

The integrated approach, from component-level interferometry through active alignment and system-level wavefront verification, ensures the microscopy subsystem delivers the speed, flexibility, and diffraction-limited image quality that fluorescence microscopy applications demand. By building precision into every stage rather than compensating for errors later, we create a system that performs predictably whether integrated into automated screening platforms, custom research setups, or high-throughput diagnostic instruments.

Byron Seabolt,
Business Development Manager at Optikos

Lars Sandströem,
Director of Business Strategy at Optikos

What Does the Dual Channel Fluorescence Imaging System Enable?

The new Optikos and Novanta design is the future of microscopy imaging.

From oncology and infectious disease diagnostics to genetic testing and neurodegenerative research, the system's dual-channel architecture, superior resolution, and modular design enable researchers and clinicians to capture the high-quality fluorescence images essential for modern biomedical investigation. The following applications represent key areas where this technology delivers measurable value:

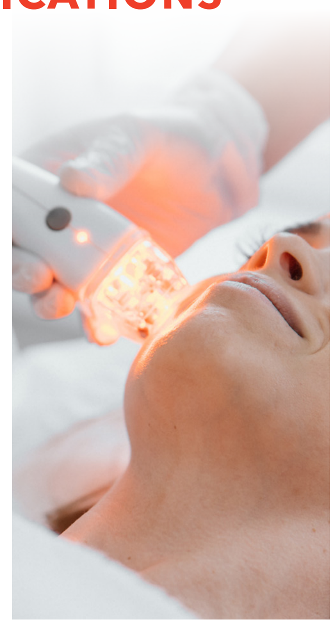
KEY APPLICATIONS

Oncology and Cancer Diagnostics

Tumor margin assessment and fluorescence-guided surgery; detection of carcinoma in situ/dysplasia; biomarker expression profiling (HER2, EGFR, PD-L1, Ki-67); circulating tumor cell detection; autofluorescence imaging to distinguish malignant versus normal tissue

Infectious Disease Diagnostics

Rapid pathogen identification on smears and tissue; viral diagnostics and serology by immunofluorescence; in vivo/ex vivo bacterial detection via fluorescence endomicroscopy; high-sensitivity fluorescent immunoassays



Autoimmune, Renal & Dermatologic Disease

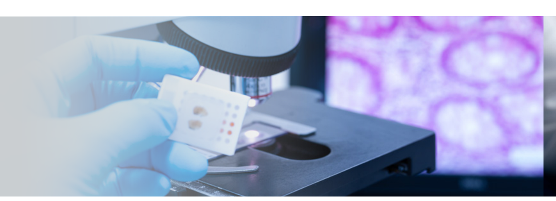
Autoantibody detection (ANA, anti-GBM, ANCA); kidney biopsy assessment for immune-complex deposition; dermatologic diagnostics for bullous diseases and vasculitis

Genetic and Cytogenetic Testing

FISH for chromosomal abnormalities, leukemia/lymphoma stratification, prenatal and preimplantation testing; RNA FISH/smFISH for spatial transcriptomics and biomarker discovery

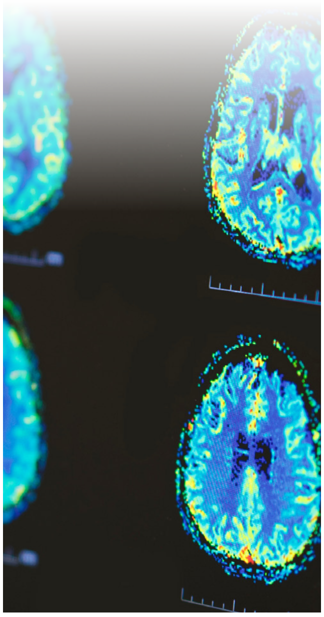
Digital and Computational Pathology

Virtual histology and virtual staining from autofluorescence images; AI-assisted analysis for automated cell counting, grading, and pattern recognition



The system is now available. **Schedule your application test today** at **www.optikos.com**

KEY APPLICATIONS



Neurology and Neurodegeneration

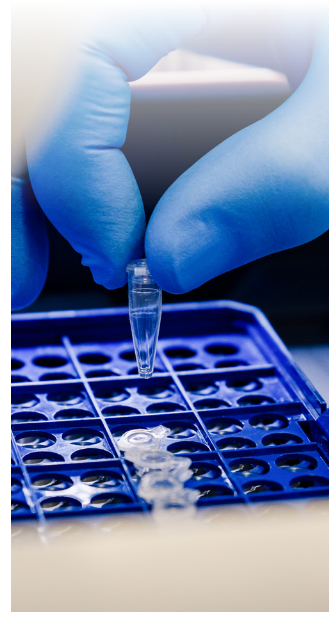
Visualization of amyloid and tau pathology; neuro-oncology imaging of tumor invasion and blood-brain barrier disruption; functional imaging of neuronal signaling and metabolism

Hematology and Immunology

Immunophenotyping in leukemia/lymphoma and immune disorders; minimal residual disease detection; immune response profiling in tissue biopsies

Microbiology, Environmental and Public Health

Detection of acid-fast bacilli and pathogens; water and food safety monitoring; biosurveillance and biothreat detection using fluorescent assays diagnostics for bullous diseases and vasculitis



Metabolic and Molecular Diagnostics

Fluorescent probes for disease-linked metabolites (ROS, pH, enzymes); label-free autofluorescence imaging for metabolic fingerprinting and tissue classification

Translational and Companion Diagnostic Research

Biomarker discovery and validation; drug-response and mechanism-of-action studies; development of companion diagnostics and imaging protocols

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