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WHITEPAPER

Precision XY Scanning for Spatial Biology, Imaging, and Life Sciences

Leveraging Novanta Precision Medicine's Motion Expertise to Enable Next-Generation Instrumentation

Executive Summary

Spatial biology and advanced life science imaging systems are redefining how researchers visualize and understand biological structures, cellular environments, and molecular interactions. These systems demand motion platforms that deliver nanometer-level precision, high throughput, and repeatable positioning under a variety of environmental and operational conditions.

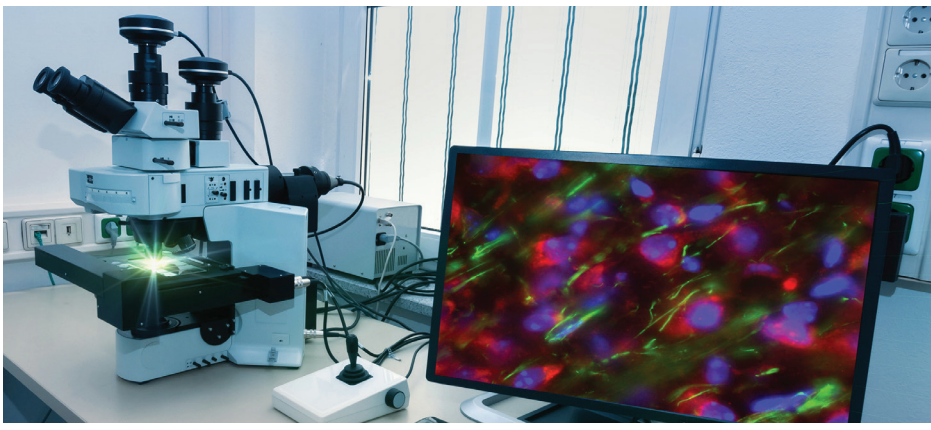
At the core of many of these innovations lies precision XY scanning—the coordinated, controlled movement of imaging platforms and sample arrays along orthogonal axes. Novanta Precision Medicine, building on the heritage and expertise of Motion Solutions in motion control and custom engineering, provides the high-performance XY stage solutions that OEMs depend on to achieve imaging that is both accurate and scalable.

The Importance of XY Scanning in Life Sciences

Spatial biology, microscopy, high-content screening, and related imaging methodologies depend on coordinated motion to:

- Precisely position samples under high magnification
- Enable large-area scanning while maintaining focus and image fidelity
- Support continuous imaging workflows that maximize throughput
- Integrate with optical, sensing, and image processing subsystems

In these contexts, XY scanning isn't ancillary—it is a core enabling technology that directly affects data quality, sample coverage, and system performance.



Advanced imaging microscope

Technical Challenges and Requirements

Typical applications such as whole slide imaging, high-content analysis, and automated microscopy present several technical demands:

Precision and Repeatability

To ensure that image tiles align seamlessly over large scan areas (e.g., slide imaging or cell arrays), positioning systems must achieve sub-micron repeatability with minimal drift.

Speed and Throughput

High throughput is essential in clinical diagnostics and pharmaceutical screening. Motion systems must accelerate and decelerate quickly while sustaining positional accuracy.

Flatness and Straightness

The planarity and geometric accuracy of motion stages directly impact focus consistency across scanning regions. Imperfect flatness can compromise image stitching and analysis.

Integration with Optics and Control

Motion systems must interoperate with optical imaging engines, sensors, focus mechanisms, and control electronics to deliver coordinated scanning and image capture.

Novanta Precision Medicine's Motion Control Expertise

Novanta Precision Medicine has built decades of motion engineering experience, delivering precision linear, piezo, and multi-axis stages for OEMs in genomic solutions, life sciences, medical equipment, and industrial automation. This expertise is now amplified by Novanta's broader capabilities in optical, imaging, and embedded systems. Specifically:

Custom XY Stage Solutions

Novanta engineers have designed XY stage assemblies tailored for sample positioning and optical scanning—including solutions where speed, flatness, and precision are paramount. These custom solutions address both standard and unique application requirements through clean-sheet designs or adaptations of proven platforms.

High-Performance Gantry Systems

For applications needing rapid focus and scanning within imaging areas, Novanta's high-speed optical gantries

combine precision motion mechanisms with ground components and tight tolerances to reduce motion settling times and improve imaging throughput.

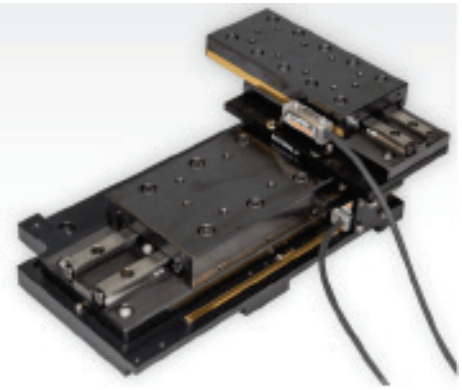
Materials and Drive Technologies

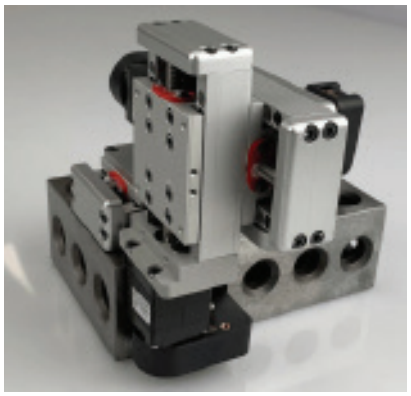
Integration of granite bases, linear motors, cross-roller bearings, and fine-resolution encoders enables performance that meets the demanding specifications of life science scanning applications.

Novanta XY Stage mounted on granite

Application-Specific Engineering

Whether it's XY stages for sample analysis or multi-axis systems integrated with piezo elements and optical feedback, Novanta's engineering team works collaboratively with OEM partners to deliver systems that align with imaging and throughput targets.





Two Novanta application-specific XY stages

Case Applications in Spatial Biology and Imaging

Slide Scanning and Whole-Slide Imaging

Precision scanning across large sample areas requires motion systems that support both high speed and tight positional accuracy to ensure flawless image mosaics. Novanta's motion platforms deliver the coordinated XY control necessary to stitch images seamlessly while maintaining consistent focus.

Cellular and Molecular Imaging

High-resolution imaging of cell cultures and tissue sections benefits from motion platforms that minimize vibration, maintain planarity, and integrate tightly with optical systems—enabling reproducible data in longitudinal studies.

High-Content Screening Systems

In drug discovery and systems biology, throughput is as critical as precision. Novanta's custom XY motion systems provide the repeatability and speed required to scan wells and microarrays rapidly while ensuring reliable sample positioning.

Enabling Seamless System Integration

Modern life science instruments combine motion control, optics, embedded vision, and advanced software. Novanta Precision Medicine's acquisition of Motion Solutions and integration into the Novanta portfolio strengthens this connection, enabling:

- Unified engineering between motion and optical imaging subsystems
- Reduced design cycles through co-innovation
- Scalable solutions from prototype to volume production
- Enhanced service and global support infrastructure

The acquisition bolsters Novanta's presence in precision medicine markets such as spatial biology, genomics, proteomics, medical robotics, and lab automation, enabling the development of intelligent subsystems leveraging combined technology portfolios.

Delivering Value to Life Science OEMs

Novanta's motion solutions deliver value in several key ways:

- **Customized Engineering**: Tailored motion platforms designed to meet unique application constraints.

- **Proven Performance:** Field-validated performance in demanding imaging and laboratory environments.
- **Scalability:** Solutions that scale from high-precision prototypes to high-throughput production systems.
- **Cross-Functional Integration:** Seamless integration with optics, control systems, and instrumentation software.

Conclusion

Precision XY scanning is foundational to the next generation of spatial biology and life science imaging tools. Through its motion control expertise and custom-engineered solutions, Novanta Precision Medicine empowers OEM partners to achieve higher precision, greater throughput, and integrated system performance—ultimately advancing scientific discovery and clinical impact.

Let's connect today and discuss how we can partner on your next project. Call **1.949.586.7442** or email us at **moso-sales@novanta.com**. For specific locations, please use the contact information below.

To explore our company and solutions further, including case studies, webinars and other research material, please visit our website at **www.motionsolutions.com**.

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