

Replacing Mechanical Motion in X-ray Imaging: Varex Multi-Beam X-ray (MBX) Technology

A Next-Generation Platform for High-Speed, High-Performance 3D Imaging

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Executive Summary

Varex Imaging's Multi-Beam X-ray (MBX) technology introduces a fundamentally new approach to X-ray generation. By replacing mechanical motion with electronically controlled X-ray beams, MBX enables faster, more robust, and more flexible imaging system architectures. This innovation unlocks new 3D imaging geometries, improves image quality, and creates a differentiated platform for OEMs seeking next-generation performance.

Why MBX Matters

- Eliminates mechanical motion constraints → faster and more reliable systems
- Enables true high-speed 3D imaging with μ s-scale switching
- Creates new system designs (static CT, inverse geometry, advanced tomosynthesis)
- Provides a scalable platform for future detector and AI integration

The Challenge with Conventional Systems

Traditional CT and tomosynthesis systems rely on mechanical motion to generate projection data. This introduces limitations in speed, increases system complexity, and creates wear-related reliability challenges. At the same time, clinical demand continues to grow for higher resolution, faster acquisition, and improved quantitative imaging.

MBX: Electronic Beam Motion

MBX technology replaces mechanical rotation with electronic beam steering by arranging multiple X-ray emitters in a linear or arc configuration. By rapidly switching between emitters, MBX simulates rotational acquisition without moving parts.

Key system requirements enabled by MBX:

- High-density focal spot arrays for sufficient projection sampling
- Microsecond-scale switching speeds
- High frame-rate detectors (e.g., photon counting detectors)
- Advanced reconstruction methods (sparse sampling, AI-based algorithms)

Core Enabling Technology: Cold Cathode Emitters (CCE)

At the heart of MBX are Cold Cathode Emitters (CCE), typically based on carbon nanotube technology. Unlike thermionic sources, CCEs do not require thermal ramp-up, enabling instantaneous emission and precise electronic control.

Demonstrated performance:

- High electron flux density ($\sim 200 \text{ mA/cm}^2$)
- Fast switching in the microsecond range
- Stable operation over tens of thousands of pulses, supporting multi-year lifetimes

Compact and Scalable Source Architecture

CCE-based MBX sources enable compact system designs with small focal spot spacing. The use of stationary anodes and shared vacuum envelopes allows high emitter density while maintaining efficient thermal management.

This compactness enables scalable system architectures, ranging from small-format applications to advanced CT configurations.

Proof of Performance

Varex has validated MBX technology through functional demonstrators with multiple emitters. Experimental imaging results confirm that rapid switching enables effective projection acquisition and motion 'freezing' in dynamic samples. These results demonstrate the feasibility of high-speed imaging without mechanical motion.

Applications and System Opportunities

MBX technology opens the door to a new generation of imaging systems, including:

- Static or inverse geometry CT systems
- Advanced tomosynthesis (e.g., breast imaging)
- High-speed dynamic imaging applications

For OEM partners, MBX provides a differentiated platform to reduce system complexity, improve performance, and create new clinical and industrial solutions.

Conclusion

Varex Multi-Beam X-ray technology represents a foundational shift in X-ray imaging. By replacing mechanical motion with electronically controlled emission, MBX enables faster, more flexible, and more scalable imaging systems. Combined with advances in detector technology and AI-based reconstruction, MBX establishes a powerful platform for the future of 3D imaging.

Partner with Varex Imaging

Varex is actively engaging with OEM partners to develop next-generation imaging systems based on MBX technology. Contact us to explore how MBX can help differentiate your platform and accelerate innovation.