Technology and Product Development:
Focus on X-ray Technologies

TRIPLE RING technologies

Triple Ring Technologies is a team of experienced engineers, physicists, and chemists who know how to collaborate. Our contact services span early-stage applied research, product development, pilot manufacturing, and entrepreneurial business development. These services **reduce risk**, **reduce costs**, and **shorten time to market**.

Understand. Simplify. Accelerate.

Triple Ring has deep domain expertise with development of X-ray systems, sources, and detectors for both medical and industrial applications. Our approach combines an experienced team of physicists, engineers, and materials scientists with dedicated infrastructure such as extensive vacuum equipment and lead-lined rooms for system development and testing. We have developed fluoroscopy, computed tomography (fan and cone-beam designs), and tomosynthesis systems for medical, dental, security screening, and industrial inspection applications with a focus on lowering X-ray dose exposure for patients and operators.

X-ray Systems: NovaRay, Inc.
Triple Ring is the sole R&D, engineering, and pilot manufacturing resource for NovaRay, Inc. Triple Ring has been responsible for all aspects of the system (Figure 1), from definition of the system architecture to the mechanical, electrical, and industrial design. The unique system uses an inverted source-detector geometry relative to traditional fluoroscopy imaging systems, a digital scanning-beam X-ray source, and a high-sensitivity detector to reduce patient exposure by 10-fold and medical staff exposure by 5-fold.

Figure 1: NovaRay X-ray Fluoroscopy System

What We Deliver

Technology Development

- Feasibility Analysis
  - System architecture definition
  - Modeling and simulations
  - Risk analysis
- Engineering
  - X-ray source and detector design
  - Complex optomechanical and electromechanical designs
  - Proof-of-concept prototypes to pilot manufacturing
- High-end imaging, reconstruction and analysis
  - Gigab/sec data acquisition
  - TeraOps/sec image processing
  - Applications engineering for Nethra Am2000™ MPPA products

Product Development

- ISO 13485-compliant quality system
- Regulatory strategy and certifications
- Product engineering
  - Product design
  - Industrial and human factors design
- Complete risk management
- Verification and validation
- Pilot to low volume commercial manufacturing of complex systems
- DFMA, Six Sigma and QFD methods for design and manufacturing

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X-ray Sources

Triple Ring designs and manufactures custom X-ray sources with features such as small focal spots, multi-spot configurations, high power, unusual transmission target geometries, and miniaturized footprints. Our modeling capability and lead-lined X-ray labs allow Triple Ring to offer integrated source design, development, and testing services.

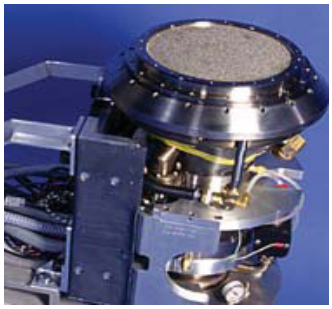

Figure 2: Scanning Beam X-ray Source

Figure 2 shows a scanning-beam array X-ray source developed and manufactured by Triple Ring. The source comprises an electron beam that digitally scans across a tungsten transmission target 30 times per second, sequentially producing 10,000 individually collimated X-ray beams (Figure 3).

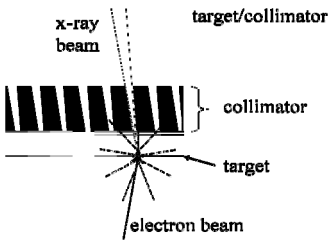

Figure 3: Scanning Beam X-ray Source Design

Triple Ring has also been instrumental in the commercialization of a miniature X-ray source, shown in Figure 4. Through a thorough examination of the design, tolerances, and manufacturing process, Triple Ring enabled our client to achieve a five-fold improvement in manufacturing yield.

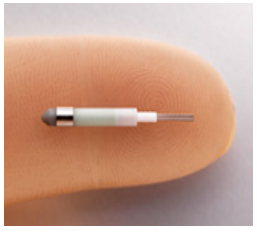

Figure 4: Miniature X-ray Tube

TRIPLE RING
technologies

X-ray Detectors

Triple Ring has designed an innovative solid-state single photon-counting X-ray detector with supreme sensitivity (high DQE) and dynamic range. The detector consists of direct-conversion CdTe tiles mounted to a custom ASIC that can be read out at MHz frame rates. The Triple Ring team also has experience with a-Si flat-panel detectors, high-performance scintillation detectors, and computed radiography systems.

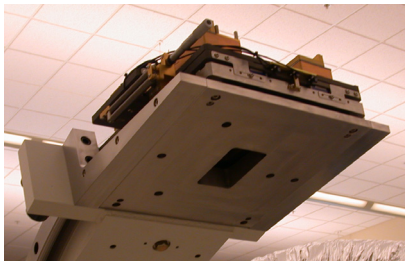

Figure 5: Photon-Counting X-ray Detector

Data Acquisition and Image Reconstruction

Triple Ring uses scalable massively parallel processor arrays (MPPA) to solve high-speed computation challenges. We offer customized PCIe protocol ATCA-compliant components for high-speed data and image acquisition, processing, and analysis. We are experts at development of image reconstruction algorithms (Figure 6).

Figure 6: Tomosynthetic Image Reconstruction

Triple Ring's headquarters in Newark, CA are housed in a 41,000 sq. ft. facility that includes dedicated laboratories for electronics, optics, radiation source development, and mechanical prototyping; and a pilot manufacturing facility.

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