TripleRing

Handheld XRF Elemental Analysis

TRIBOGENICS

Client
Tribogenics

Practice Areas
Imaging, Robotics & Radiotherapy

Core Disciplines
AI & Advanced Algorithms
Systems Engineering
Photonics & Imaging
Applied Physics

Challenge

While Tribogenics' novel X-ray source created significant opportunities for compact, low-cost XRF instrumentation, it also introduced a fundamental measurement challenge. The emitted X-ray spectrum varied from shot to shot, throughout the lifetime of the source, and between individual sources, reducing the accuracy and repeatability of elemental concentration measurements.

With first-generation instruments achieving only mid-80% PMI accuracy on a limited alloy set, Tribogenics challenged Triple Ring to develop the physics-based algorithms and analytical framework needed to improve measurement robustness and support development of a more competitive next-generation instrument.

Solution

Triple Ring developed a comprehensive modeling and algorithm framework to understand, compensate for, and reduce the effects of spectral variability.

The program centered on:

- Building a high-fidelity Monte Carlo digital twin of the complete XRF measurement system
- Modeling X-ray source behavior, sample interaction physics, detector response, and system geometry
- Developing signal processing and spectral analysis algorithms to improve elemental measurement accuracy
- Designing and validating a real-time spectral compensation approach using a secondary detector
- Using simulation-first methods to isolate error sources, evaluate design tradeoffs, and de-risk future hardware development

Find more case studies on our website: