

## Systems Integration and Software Development

Ball is helping solve our nation's toughest intelligence data processing challenges through complete end-to-end PED solutions for the Intelligence Community. We use Agile development practices to engineer open, scalable architecture solutions, develop independently deployable PED tools, and rapidly integrate the latest R&D advancements into effective tools.

### End-to-End TPED Solutions

We are the experts for end-to-end OPIR, airborne, spectral and other sources. We developed a reusable architecture framework for multiple domains and an integrated OPIR TPED system which achieved Initial Operations Capability in 2008 and Full Operations Capability in Dec 2010 supporting over 120 analysts conducting 24/7 integrated operations.

We established the Spectral Airborne Reachback Cell for NASIC, unique because the data is collected and processed within the operational area of responsibility, while exploitation takes place within the CONUS.

This remote server capability provides automated remote processing, an ability to perform data triage, the ability to transfer selected high-priority data, and other functions to create a more efficient mission.

### Cloud Technology Integration

Ball has been an early adopter of new technologies and architecture approaches to include the set of technologies commonly labeled cloud technologies. We leverage virtualization and platform as a service paradigm in deployed OPIR and spectral PED systems. As part of a recent OPIR TPED effort, we successfully transitioned existing processing to a services-based architecture to enable the development of software as a service. We have experience with the IC Information Technology Enterprise standards and have successfully deployed capabilities to the Amazon GovCloud.



### Real Time Processing and Exploitation

Ball has invested in the technologies necessary to migrate advanced algorithms and techniques from an interactive phase 2 and 3 environment into a real-time framework. We have demonstrated understanding of technologies such as cluster computing, multi-threading, code optimization, and GPU processing. More importantly, we understand the data, the target phenomenology and the algorithms such that the automation process does not impact mission performance. The result is better real-time system performance to improve mission execution.

### Processing and Exploitation Tools

Ball has a strong heritage of providing remote sensing processing and exploitation solutions to the intelligence community. We have been innovators in the exploitation of remote sensing data for more than 20 years. We developed Opticks, the open source, remote sensing framework for GEOINT. We also developed Palette, the integrated tool suite for processing all OPIR sensor data, event and scene based. We have deep experience in automated, batch and human-interactive processing; enterprise PED, R&D, and standalone operations; streaming data and file-based data processing for near-real-time and offline analysis. Our tools and algorithms embody our sensor expertise.

### Large Data Processing and Exploitation Infrastructure

Ball has designed and integrated high performance, high volume PED infrastructures leveraging state-of-the-art technologies. We integrated NASIC's OPIR and airborne PED infrastructure on time and under budget. We are a leader in virtualization to increase reliability and drive down acquisition cost and schedule. We have engineered highly scalable, national data archive solutions (>5 PB) to support remote PED analysis within large data environments. And, we have built high performance, scalable file systems to provide analysts with data when they need it.

Ball provides world-class geospatial and space intelligence technologies and solutions to those who guard and guide our nation.

## Ball Aerospace

Ball employs the scientists, engineers and developers who analyze, interpret and model sensor data and who innovate and prototype tools, processes and products to solve our customers' most challenging problems.

## Advanced ISR SOLUTIONS



Ball Aerospace delivers world-class geospatial and space intelligence technologies and solutions. Our Advanced ISR Solutions business area has a deep history of consistently providing innovative support within cost and schedule constraints.



Ball Aerospace & Technologies Corp.

## Advanced ISR Solutions

Advanced ISR Solutions is one of seven business areas within Ball's Systems Engineering Solutions organization. Our legacy is providing innovative geospatial R&D, operational support, and systems to satisfy mission requirements in a cost effective way.

### Research and Development (R&D)

Ball employs the scientists, engineers and developers who analyze, interpret and model sensor data and who innovate and prototype tools, processes and products to solve our customers' most challenging problems.

Our focus is on remote sensing data, particularly overhead persistent infrared (OPIR), multispectral and hyperspectral.

Our team distinguishes itself through immersion in data, understanding warfighter needs, prototyping in an operational environment, and working with system developers to transition capabilities into tools.

### Sensor Characterization

We have a deep understanding of sensor performance characteristics and how to link those characteristics to product requirements and operational needs. We have real-world experience in on-orbit sensor characterization and calibration, sensor performance monitoring and trending, radiometric and spectral calibration studies, advanced spectroscopic and polarimetric imaging modeling and analysis, and geolocation calculation based on astronomical or geospatial features.

### Electro-Optical, Infrared and Atmospheric Phenomenology

Our products and services enhance our customers' understanding and exploitation of target phenomenology and mitigate atmospheric effects. We have developed algorithms for aerosol and cirrus optical depth, atmospheric compensation, and off-nadir line-of-sight (LOS) atmospheric



For more than twenty years, Ball has consistently provided pioneering geospatial intelligence support for a variety of areas including OPIR, hyperspectral, thermal infrared (TIR), synthetic aperture radar (SAR), over the horizon (OTH) and integrated production.

Our customers include:

- The National Air & Space Intelligence Center (NASIC)
- The National Geospatial-Intelligence Agency (NGA)
- The Department of Homeland Security (DHS)
- The U.S. Army
- Other Department of Defense (DOD) and intelligence customers

characterization. We provide utility assessment for battlespace awareness and environmental intelligence products.

### Modeling and Simulation

Ball develops models of targets and scenes to aid understanding of sensor data, facilitate algorithm development and support in-depth analysis of high-value targets. Our scientists perform missile and plume modeling, target and scene generation using physics-based models, synthetic scene generation using proxy sensor data, reflectance retrieval in complex environments, and sensor optical modeling. We also provide test support to customers including the Missile Defense Agency's External Sensors Lab.

### Advanced Processing and Exploitation

Ball develops advanced processing and exploitation techniques and transitions these capabilities into prototype tools for operations and analysis. In the field of signal and image processing, our algorithms can detect and track dim targets, suppress background noise, enhance signals, and exploit super-resolution techniques. We are accomplished in temporal processing and analysis, multi-processor and graphics processing unit (GPU) high-performance computing, algorithm process improvements and multi-sensor fusion.

### Space and Counterspace Analysis

Ball provides exceptional high-quality technical assessments of capabilities in space and counterspace. Our work includes all-source intelligence research (open source, IMINT, SIGINT, HUMINT, etc.) combined with detailed engineering reviews and trade-off analyses of system characteristics, capabilities and performance. With our team of intelligence, operations and space systems design experts, we assess threats to space systems and deliver tailored products to decision makers in the Intelligence Community (IC) and DOD to enable activities such as strategic planning; field operations; and targeting, policy and acquisition.

## Operational Support to the Warfighter

The Ball operations team provides GEOINT analysis-related production support to NASIC and other DOD and IC customers. Our analysts have world-class expertise in OPIR, SAR, Spectral, TIR, OTH, LOS, and Ground Motion Target Indicator-Forensic (GMTI-F) intelligence data, and tailor products to customers' needs, including:

- Analytical reports
- Technical publications
- Detailed graphics
- Maintenance databases
- Summary data and spreadsheets

Ball provides instruction on the techniques and tools used in the tasking, processing, exploitation and dissemination (TPED) process including a certification program, training sessions and a qualification program. Our subject matter experts provide mentoring and ad hoc training on complex problems and advanced GEOINT analysis techniques.

### OPIR Production and Analysis Support

Ball leads the way in providing robust and innovative OPIR production support. We take on some of the most complex and exciting intelligence challenges – from event extractions and trending to OPIR fusion and process improvement. Our team of more than 90 engineers and scientists exploit remotely sensed data and produce intelligence products from OPIR data.

In addition, we collaborate with customers to produce requirements for new intelligence taskings, develop tools and procedures to assist with intelligence studies on OPIR data validation, and provide request for information support.

The data produced by our OPIR production team supports national intelligence agencies such as NGA, DHS and the Defense Intelligence Agency by providing technical intelligence products derived from OPIR sensors.



### Integrated Forensic Analysis

Our experts conduct forensic analysis of GEOINT data against specific targets and requirements, defining patterns of life and lines of communication, and leading to actionable intelligence. We have real-world experience in spectral operational support, including Phase 1, 2 and 3 spectral analysis of the battlefield and war-making production facilities, helping decision makers identify possible targets and infrastructures that are hostile to U.S. interests.

### MASINT Operational Support

Ball has the experience to conduct over-the-horizon radar analysis and production through complex Phase 2 and 3 analysis and processing, exploitation and dissemination (PED) activities for OTH data. We provide completed analysis reporting to the IC on classified networks.

Additionally, we provide SAR advanced geospatial intelligence (AGI) operational support. We perform routine PED on SAR AGI data to produce SAR AGI analyses, including two-color multiview, coherent change detection, dynamic imagery and radar cross-section (RCS) products. Our team runs RCS predictions and validates computer-aided design models using government-provided Xpatch or similar software.

We also provide LOS radar production and operations & maintenance support. We perform LOS analysis and production on-site at NASIC and routine PED on LOS radar metric and signature data from a variety of LOS radar sensors on aerodynamic, missile and space targets.