



PROMETHEUS INC.

MATHEMATICS FOR SCIENCE AND INNOVATION



Prometheus Inc.

Women-Owned Small Business

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OUR OBJECTIVE IS to employ sophisticated mathematics to solve some of the most vexing defense problems of Government agencies, prime contractors, and industry.



ABOUT US

Leadership and Structure

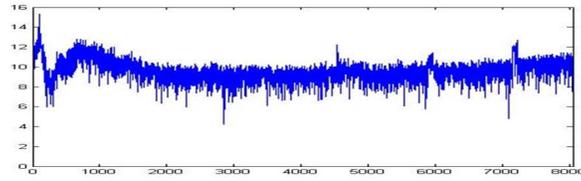
Dr. Jim Byrnes, formerly Professor of Mathematics at the University of Massachusetts, has headed Prometheus Inc. since its inception in 1983. He is well known in the field of applied harmonic analysis. In addition to leading many significant applied mathematical efforts for the United States Department of Defense, Dr. Byrnes has organized and directed nine NATO Advanced Study Institutes (www.nato-us.org), bringing together international academic, government and industry experts and students to further the fields of signal processing, and other areas at the intersection of mathematics and engineering. Our structure allows us to form highly specialized, efficient teams with the appropriate expertise to solve problems of deep concern to DoD, its prime contractors and others.

Mission

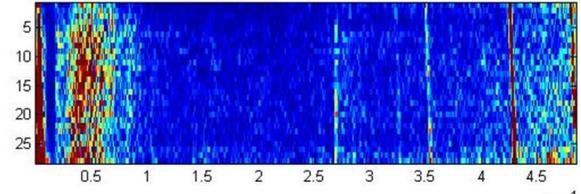
Prometheus Inc. is a mathematics and engineering research firm that specializes in the application of high-level mathematics to modeling, simulation and signal processing. Our objective is to improve our customers' system performance by the formulation, design and integration of accurate and computationally efficient algorithms. Our primary markets are DoD and its collection of large civilian contractors, as well as other developers of radar, sonar, and other communication systems. In most cases we completely eliminate the need for changes in hardware while significantly improving system performance.



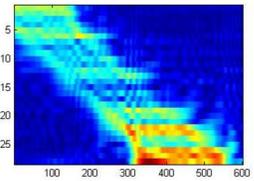
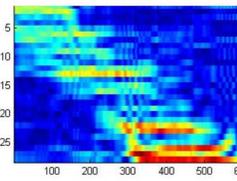
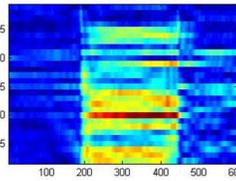
Operational Scene Generated by MIRK



Log of matched filter amplitude



MIRK feature map



Feature detail

OUR GOAL IS to develop algorithms and software that avoid, and in most cases completely eliminate, the need for changes in hardware, reducing system costs while improving performance.

Goals

- Provide efficient mathematical solutions for straightforward integration
- Dramatically improve system performance
- Reduce system costs
- Solve critical software implementation problems

Core Competencies

With over two centuries of combined applied mathematical experience, Prometheus Inc. brings together academic and industry experts in acoustics, antenna array design, applied probability, digital filtering, Fourier analysis, optimization, pattern recognition, scattering theory, and signal processing. When you work with a team of Prometheus Scientists you will have top-level applied mathematicians focusing on the specific problem of interest to you.



Past and present Prometheus clients include:

- **U.S. Navy**
 - Naval Sea Systems Command, Integrated Warfare Systems 5A
 - Naval Sea Systems Command, Naval Undersea Warfare Center, Newport
 - Naval Sea Systems Command, Naval Surface Warfare Center, Panama City
 - Office of Naval Research, Mathematics, Computers, and Information Research Division, Arlington
 - Space and Naval Warfare Systems Command, San Diego
- **Defense Advanced Research Projects Agency**
 - Defense Sciences Office
 - Special Projects Office
- **U.S. Air Force**
 - Brooks AFB / Citybase
 - U.S. Air Force Office of Scientific Research, Mathematics and Information Sciences
 - U.S. Air Force Research Laboratory, Sensors Directorate, Rome, New York
 - Wright Patterson AFB, Air Force Material Command
 - European Office of Aerospace Research and Development
- **U.S. Army**
 - Space and Missile Defense Technical Center, Huntsville
 - Army Research Office, Research Triangle Park, NC
 - Army European Research Office, London
 - DASD Munitions and Chemical Matters Assistant for Munitions and Chemical Matters, DASD for Environment, Safety and Occupational Health Rapid Fielding Directorate, OUSD AT&L.
- **Raytheon**
- **ONR Global**
- **BBN Inc.**
- **Cisco Systems**
- **Hale and Dorr**
- **Defence Science & Technology Office Australia**

Prometheus Inc. has worked for and with a wide array of Federal agencies and industry leaders to develop solutions to complex defense problems and improve performance of defense systems.

Prometheus has carried out collaborative work with:

- Raytheon
- Huntington Ingalls
- Auburn University
- Applied Research Laboratory/Penn State University
 - Anteon/General Dynamics Corporation
 - GDE Systems (now BAE Systems)
 - SEA CORP
 - Calibre Systems
 - EM Solutions
 - HDR Inc.
 - MD Helicopters
 - Northern Defense Industries
 - Ohio State University
- Riptide Autonomous Solutions
 - Teledyne Benthos
- University Corporation for Atmospheric Research



SUCCESSSES

Prometheus has developed and controls the intellectual property for the following applications: remote material discrimination with radar and sonar; feature-based pattern recognition; broadband reverberation modeling; closely spaced object discrimination; waveform diversity and space-based radar; and the Advanced Acquisition Decision Aid. In addition to developing intellectual property through contracts, Prometheus Inc. has a longstanding record of funding internal research and development (IR&D), which it applies to its clients' issues.

Materials Identification

Prometheus Inc., supported by the U.S. Navy, U.S. Air Force and National Reconnaissance Office (NRO), has developed algorithms leading to the automatic determination or discrimination, in intense clutter, of organic materials including foliage, people, chemicals and biologicals at various temperatures and moisture content. Our algorithms compute materials identification from scattered measurements, have good noise rejection and are robust to clutter. For sonar, quoting from the posting on the official DoD website announcing the FY11 (funded in FY12) Rapid Innovation Fund (RIF) awards, MIRK (Material Identification Reflectivity Kernel) "Provides the warfighter the capability to reliably detect bottomed submarines and mines in real time with fewer false alarms, significantly increasing the fleet's ability to defeat Anti-Access / Area Denial (A2/AD) threats." In an FY15 Program Prometheus has demonstrated a 62% reduction in false contacts with no loss of true targets in the AN/AQS-20A Mine Hunting Side Look Sonar in cooperation with Raytheon.

Waveform Diversity

Prometheus Inc. is on the forefront of the evolving field of waveform diversity. Our theme in this work is to use the flexibility in waveform switching and array processing available in the emerging generation of phased array radar systems in order to optimally achieve the operational aims of the system. An example is our generalization of the PONS (the patented Prometheus Orthonormal Set) method of waveform construction, whereby we have shown how to overcome the range aliasing problem for space-based radar by employing multiple PONS-type waveforms in both time diversity and spatial diversity modes. PONS-based waveforms are now being used in a highly classified U.S. military radar system. We have designed and can generate orthogonal chaotic frequency sweeping (CFS) waveform sets to allow multiple sources operating at the same time and same frequencies to communicate uniquely.

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Broadband Torpedo Reverberation Modeling

Prometheus Inc. has simulated, for the first time, real-time broadband torpedo reverberation. The “noiselet” reverberation simulator compares extremely well with the previous Weapons Analysis Facility (WAF, NUWC Newport and DSTO Adelaide, Australia) reverberation generator with significantly fewer limitations and at lower cost. It outperforms the previous WAF reverberation generator for the case of broadband signals. Also, it is not limited to the case of Gaussian noise and does not require any stationarity assumptions. Our computations increase linearly with the number of array elements whereas those of the previous method used in the WAF increase with the cube of the number of elements. This advance is allowing the U.S. and Australian Navies to test their torpedoes in real-time at significantly reduced cost. Broadband Reverberation Modeling is implemented in the NUWC Newport and DSTO Adelaide Weapons Analysis Facilities (WAFs).

Advanced Acquisition Decision Aid

The AADA model and software is designed to: support investment decisions among highly diverse proposed technology investments; measure predicted asset performance with respect to a diverse range of high-level objectives; account for technological risks, uncertainty in future objectives and threats, and uncertainty in future budgets. AADA operates by applying genetic algorithms to the problem of determining an estimate of the utility of future assets by performing near-optimal allocation of assets to objectives. This technology builds upon the Military Aircraft Allocation Planner (MAAP), developed for the Air Force under a Phase II SBIR contract. The National Oceanic and Atmospheric Administration has also successfully applied AADA to allocate a \$100 million research budget to approximately \$1 billion of proposals.

Feature Based Pattern Recognition

With funding from the U.S. Navy’s Office of Naval Research and the Raytheon Company, in combination with substantial IR&D support, Prometheus Scientists are using noncommutative group harmonic analysis to automatically detect and identify undersea mines in side scan sonar data. This technique has been validated on real data and is ready for implementation as well as application in other arenas such as passive sonar, radar, EO/IR object detection and classification, cryptography, landmine detection, and to automatically identify anomalies in CAT and MRI scanning information. The underlying mathematics is presented in the monograph “Group Filters and Image Processing” (Psypher Press, 2003) by two Prometheus Principal Scientists, Myoung An and Richard Tolimieri.



We are problem solvers. The specific US DoD problems which we have attacked and solved with our algorithms and code, usually created specifically for each problem, should be thought of as examples of our capabilities and expertise, not as boundaries on what we can accomplish.

Prometheus Object Detection Software (PODS)

The purpose of PODS is to significantly reduce video imagery review efforts. PODS is a fast, cost-efficient tool for reducing the data volume to image frames containing targets of interest. PODS can be used as an autonomous data reduction tool or as an interactive cuing tool. The software analyzes uncompressed red/green/blue (RGB) video imagery and returns screen cues of detected targets; an audio cue at the starting frame containing a detection; and an uncoded text file containing detection results. PODS has been successfully applied, under Pentagon funding, to provide a more than 1000-fold reduction in required operator time in the analysis of undersea video taken to locate and discriminate chemical munitions canisters dumped by the U.S. Navy near Pearl Harbor during and after World War II. See <http://www.prometheus-us.com/oz/anomaly-detect.mp4>.

CORE ADVANTAGE

There are unambiguous reasons for agencies and prime contractors to work with a professional consultancy with a history of achievement and an abundance of intellectual property. In addition to providing excellence in Applied Mathematics, Prometheus Inc. has a long history of successful projects with the United States Department of Defense and industry partners. Prometheus has had particular success in the Small Business Innovation Research (SBIR) program. We are currently midway in our tenth Phase II (of 11 Phase I's) and have had multiple Phase III contracts. In addition, we received a Rapid Innovation Fund (RIF) contract, during which we successfully tested our materials identification algorithms in the ANN/BQQ-10 sonar. As a small, woman-owned business, Prometheus provides both the expertise and the flexibility to solve your complex problems. Our small size also insures that clients will receive personal attention from Dr. Jim Byrnes, President. Our past performance points to our ability to transition ideas to functional software and algorithms. Prometheus Inc. has the authorization to work at your facility on SECRET projects and has several Scientists currently working at the SECRET level.



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