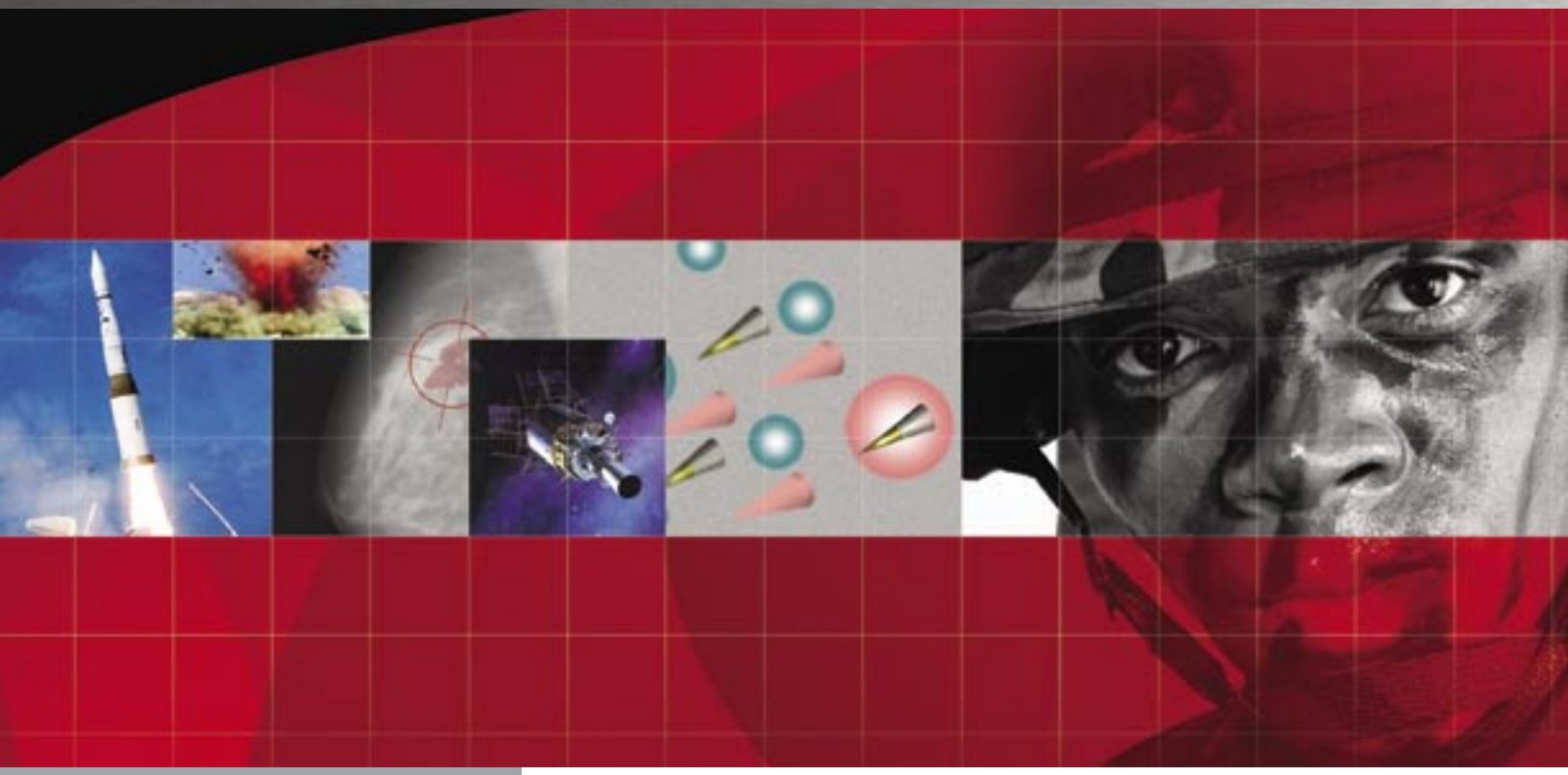
Interdisciplinary Application of Medical and Missile Defense Technology



Summary

- Image Processing for Early Detection of Breast Cancer
- Decision Architecture for Discrimination of Cancerous and Benign Masses
- 2-D Gel Protein Expression Analysis for Early Detection of Disease
- Response Surface Methodology for Prediction of Probability of Disease from Clinical Data

The Space and Missile Defense Command Technical Center is applying missile defense detection and discrimination algorithms/architectures to the detection and prediction of cancer and heart disease.

There is currently no robust methodology for integrating mammography, ultrasound imagery, proteomics, genomics, and environmental/lifestyle factors into a Decision Support System (DSS) for early detection and prediction of risk of disease in women. The development of a DSS with this capability will require expertise from several disciplines (image processing, radiology, decision architectures, proteomics, genomics, micro-array analysis, 2-D Gel electrophoreses analysis, and clinical data). Windber Research Institute (WRI), Walter Reed Army Medical Center (WRAMC), the Joyce Murtha Breast Care Center (JMBCC), and the U.S. Army Space and Missile Defense Command (SMDC) have brought together the expertise in these disciplines to initiate development of a DSS.

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Technical Center

Overview

SMDC has expertise in image processing algorithm development that can be used for early detection of anomalies in mammography and ultrasound images and unknown proteins in 2-D gel electrophoresis images. SMDC has expertise in decision architectures that will support fusion of mammography and ultrasound results with other data for prediction of risk of disease. WRI has expertise in proteomics and genomics and is developing databases of environmental and lifestyle information on women. WRI also has expertise in educating and training physicians and patients.

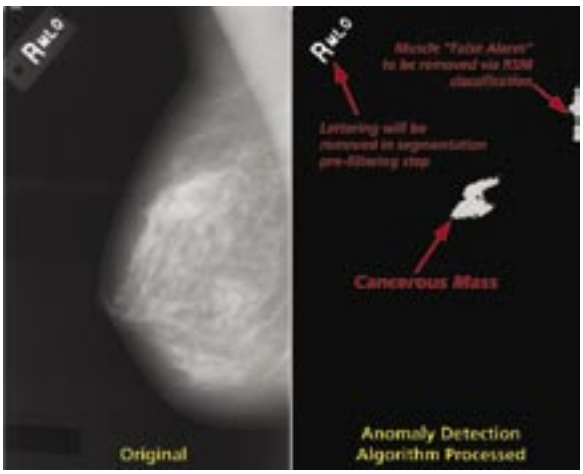
Benefits for Tomorrow's Defense

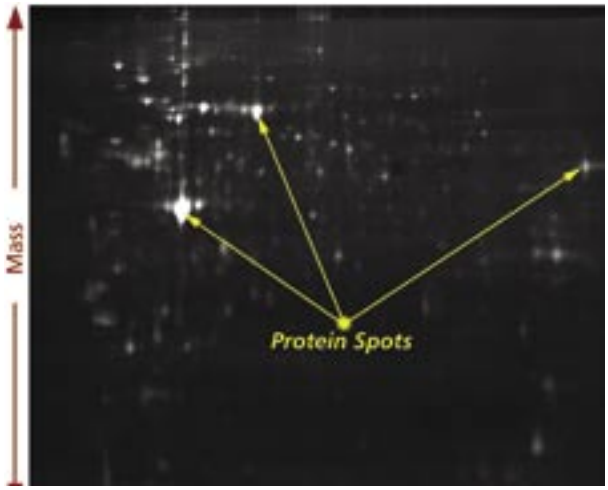
It has recently been recognized that methodologies and techniques being used for Ballistic Missile Defense Discrimination Applications appear to have direct relevance and application to Breast Cancer Diagnosis and vice versa. The two problem sets are amazingly similar in a number of respects. For example, both have high penalties for false negatives (missed cancer detections or missed warhead detections) and penalties for false positives (unnecessary biopsies or wasted, costly interceptors). Also, both utilize sensor imaging and interpretation techniques with classification algorithms.

The Army's Space and Missile Defense Command (SMDC) is developing image processing techniques and a discrimination architecture for ballistic missile detection and discrimination. This architecture provides a plug-and-play capability, which allows different algorithms, discrimination features, and classifiers to be combined to form individual decision architectures based on fused data from multiple sensor types. For example, the detection of cancer in breast tissue is as challenging as the detection of a re-entry vehicle in clutter. The medical community has a large unclassified database that can be used for developing and testing these algorithms; therefore a collaborative effort is a benefit to both the medical community and SMDC.

Technical Concept

The objectives of this effort are: (1) develop a decision support system based on SMDC's Missile Defense Decision Architecture that integrates mammography, ultrasound, proteomics, genomics, environmental, and lifestyle data for early detection and prediction of risk of disease in women; (2) process Windber Research Institute and Walter Reed Army Medical Center databases to train and validate DSS; (3) develop a user friendly clinical interface to DSS; and, (4) train radiologists and physicians on the use of the system.





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