

Innovation

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.

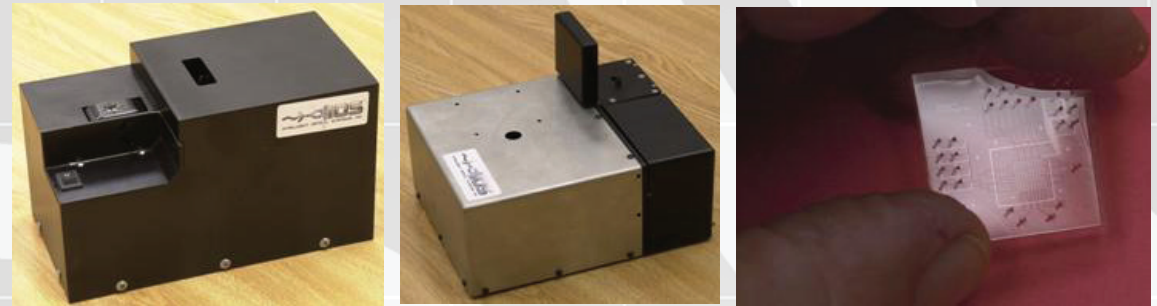


Figure 1 – Left: A battery operated field-usable labelless optical reader and software to automate the measurements and data analysis. Center: A field-usable, battery-powered microfluidic system to perform the required assays and software to automate the assays. Right: Microfluidic chips to carry out four or more assays simultaneously.

Field-Usable Portable Multiplexed Device for Biomarker Detection in Body Fluids

- An easy-to-use, portable, rugged, diagnostic, and monitoring medical device for field use is needed for military personnel in order to provide timely and proper treatment
- Intelligent Optical Systems (IOS) developed a flexible diagnostic platform for the automated detection and quantification of biomarkers in body fluids
- A modular design was used to build one of the smallest reported labelless optical detection units for multiplexed assays evaluation of samples for field use and a miniaturized microfluidic platform to perform automated multiple assays quantitatively and rapidly in the field
- The Air Force will benefit from a rapid health assessment based on low sample volumes (e.g., a small drop of blood) that verifies that a person is fit to perform critical tasks before being sent on a mission, and also reduces medical costs by enabling early treatment of illness

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SBIR Topic Number:
AF06-035

SBIR Title:
Development of a
Deployable Biomarker-
Based Health Biomonitor

Contract Number:
FA8650-07-C-6757

SBIR Company Name:
Intelligent Optical
Systems, Inc.,
Torrance, CA

Technical Project Office:
AFRL Human Effectiveness
Directorate, Wright-
Patterson AFB, OH

Air Force Requirement

U.S. military personnel often operate in extreme conditions and environments, and chronic and acute illnesses must be diagnosed and treated immediately and effectively to ensure mission success. It is thus essential to bring the most recent advancements in clinical diagnostics to applications in battlefield environments. An easy-to-use, portable, rugged, diagnostic, and monitoring medical device for field use is needed for military personnel in order to provide timely and proper treatment.

SBIR Technology

Under this SBIR contract, Intelligent Optical Systems (IOS) developed a flexible diagnostic platform for the automated detection and quantification of biomarkers in body fluids. A modular design was used to build one of the smallest reported labelless optical detection units for multiplexed assays evaluation of samples for field use and a miniaturized microfluidic platform to perform automated multiple assays quantitatively and rapidly in the field (see Figure 1).

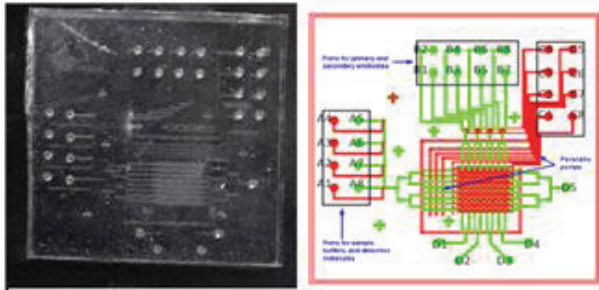


Figure 2: Microfluidic chip and chip schematic for performance of four separate assays.

This project focused on the integration of advanced optical detection techniques, microfluidic chips, and specifically designed biological assays to demonstrate biomarker analysis in a portable unit. Miniature microfluidic chips made of Polydimethylsiloxane (PDMS) using photolithography techniques were interfaced to a biologically active chip to perform assays. Fluidic valves and peristaltic pumps were integrated into a microfluidic chip that was used to channel the reagents and samples over the biologically active chip. The fluidic valves and pumps on-chip are driven by microcontroller-operated miniature solenoid valves and diaphragm pumps in the compact package. The microfluidic chips were prepared in collaboration with the Nanofabrication Group at Caltech, pioneers in the field of micro and nanofabrication (see Figure 2).

Additionally, IOS concentrated on constructing a miniaturized, field-usable prototype. The fluidics systems and software were integrated into the prototype, and the prototype was tested and characterized for the ability to detect both DNA and protein biomarkers on a single chip. The optical and fluidic subsystems were individually packaged to be suitable for field use. The user interface was designed for ease of operation. As the microfluidic chip is a disposable item in body fluid analysis, batch fabrication and interface issues were given careful design consideration.

Potential Application

The technology demonstrated by IOS can form the basis of a family of hand-held, fieldable diagnostic devices for assessing the health of military personnel in the field. The important breakthrough achieved in this project was showing that all components necessary to perform the tests can be miniaturized to a hand-held format. The Air Force will benefit from a rapid health assessment based on low sample volumes (e.g., a small drop of blood) that verifies that a person is fit to perform critical tasks before being sent on a mission, and also reduces medical costs by enabling early treatment of illness. Additionally, the device can find applications in detecting contaminants and pathogens in water samples based on tailored multiplexed assays.

Company Impact

This SBIR contract has enabled IOS to advance in the field of medical diagnostics and development of field usable monitoring devices. The device platform that has been developed can be adapted to a variety of clinical applications, including emergency medicine. The potential uses are also expected to extend to companion diagnostics.

The microfluidics systems developed as part of this SBIR project can be easily adapted to other assay platforms based on chemiluminescence, fluorescence, colorimetric, electrochemical, and other techniques. The funding received under this program has catalyzed the development of a robust medical diagnostics and field-usable system development program at IOS. This SBIR project has further provided IOS with the opportunity to demonstrate that it has the capabilities and talent to contribute solutions to critical challenges in the defense sector.



SBIR/STTR

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