Low-Cost Airborne Biological Contaminant Sensor

For real-time detection of bacteria, viruses, and fungal spores

Applications for the FAST BioSensor

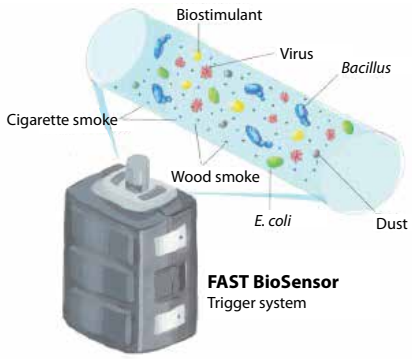
- Health care
  - Operating rooms
  - Isolation wards
  - Formulations and compounding
- Manufacturing
  - Pharmaceuticals
  - Food and beverages
- Hospitality
- Security and threat awareness

The Problem: Existing contamination identification sensors are too costly for general use

Aerosolized bacteria, viruses, and fungal spores (bioaerosols) represent sources of infection or contamination in several industries—including health care, pharmaceuticals, and food processing. In these industries, air quality monitoring is critical to the health and safety of consumers and employees. However, adequate solutions to monitor the presence of these bioaerosols in a real-time, cost-effective manner do not exist. Current bioaerosol detection solutions using fluorescence techniques can cost tens of thousands of dollars. Cheaper alternatives—such as light-scattering total particle detectors—exist, but their inability to distinguish between inorganic and organic particulates could result in undetected biological contaminants.

Introducing the FAST BioSensor: A low-cost, rapid warning system

Researchers at RTI International have developed a novel, low-cost bioaerosol early warning device—the FAST BioSensor—that can detect various airborne biological contaminants. Laboratory testing has shown that the FAST BioSensor can signal the presence of aerosols and bioaerosols (e.g., household dust, bacteria, smoke, and some viruses) ranging from 0.15 microns to more than 5 microns (adjustable based on application) in real time. A simple design and low unit cost enables these detectors to be used individually or to be networked in distributed arrays that will enable continuous, real-time monitoring of critical areas for the presence of airborne contaminants.

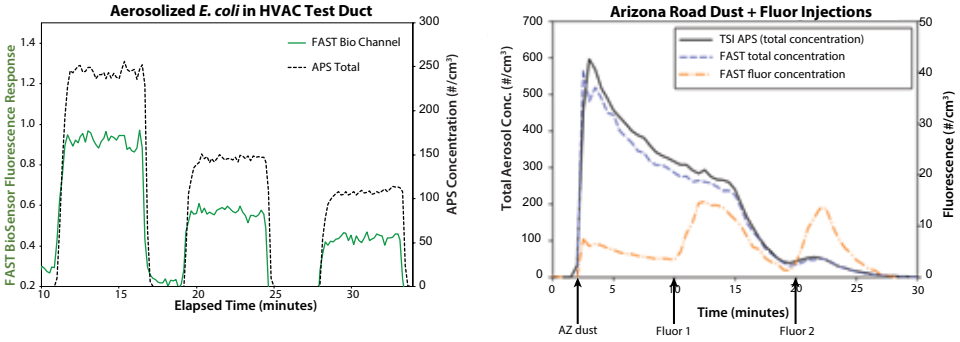


The FAST BioSensor provides a means for total aerosol concentration and bioaerosol detection in real time.

The Technology

The FAST BioSensor detects airborne biological contaminants through an innovative design that uses a laser and patented technique to easily differentiate between inorganic and organic particles. When illuminated by a laser, bioaerosols that contain bacteria, viruses, or fungal spores emit photons with a characteristic fluorescence signal. Inorganic particles simply scatter the laser light without emitting fluorescent photons. As air passes through the laser inside the FAST BioSensor, fluoresced and scattered photons are collected and counted separately to distinguish bioaerosols—even in the presence of potentially interfering dust and other inorganic particles. The FAST BioSensor's novel design allows for a low-cost sensor that provides high-confidence, high-efficiency detection of bioaerosols with near maintenance-free operation.

Attribute	Current or Target Performance
Detection of biological materials	Full range of biological particles—including bacteria, viruses, and fungi
Response time	< 1 minute
Data acquisition rate	1–60 seconds with 1 hertz averaging
Sensitivity	Expect ≤ 100 particles/liter (L)
Probability of detection	Expect 90%
Flow rate	Adjustable 3–50 L/minute
Size and weight	< 1.5 feet^3 and < 9 pounds
Power and noise level	< 4 watts and < 35 decibels
Consumables	None (except electricity)
Communications	Will develop fully networked capability
Purchase cost	Expect < $1,000
Operation cost and maintenance	Minimal, minor monthly cleaning
Temperature and relative humidity	TBD, objective is -20°–45°C; 0%–95%
Skill level and training	Minimal



A preparation of *E. coli* bacteria was aerosolized and injected into a ventilation test duct at three different times and concentrations (left graph). In this test, because the bioaerosol used was mostly bacteria, the APS concentration should mirror the bioaerosol detection by the FAST. In a second test (right graph), a high concentration of Arizona Road Dust (standard test dust; AZ dust arrow) was injected into a dynamic test chamber followed by two, much smaller injections of bioaerosol simulant (fluorescently tagged microspheres; Fluor 1 & 2 arrows). The FAST detected the fluorescent aerosol despite the high concentration of obscuring dust.

Advantages

- Passive detection in real time
- Novel capture technique distinguishes between inorganic and organic particles
- High throughput and flow rate
- Small form factor/footprint
- Minimal maintenance (quick monthly cleaning)
- Low cost to operate
- Easy to scale

More Information

The FAST BioSensor has a broad range of potential applications—including health care, industrial, food service, and defense. To explore co-development and partnership opportunities, contact **Brad Mooring** at **919.248.4239** or **BMooring@rti.org.**

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