Three-dimensional (3D) optical coherence tomography (OCT) is an advanced method of noninvasive infrared imaging of tissues in depth. Heretofore, commercial OCT systems for 3D imaging have been designed principally for external ophthalmological examination. As explained below, such systems have been based on a one-dimensional OCT principle, and in the operation of such a system, 3D imaging is accomplished partly by means of a combination of electronic scanning along the optical (Z) axis and mechanical scanning along the two axes (X and Y) orthogonal to the optical axis.

In 3D OCT, 3D imaging involves a form of electronic scanning (without mechanical scanning) along all three axes. Consequently, the need for mechanical adjustment is minimal and the mechanism used to position the OCT probe can be correspondingly more compact. A 3D OCT system also includes a probe of improved design and utilizes advanced signal-processing techniques. Improvements in performance over prior OCT systems include finer resolution, greater speed, and greater depth of field.

Figure 1 includes a simplified schematic representation of the optical subsystem of a typical prior OCT system. In this system, near-infrared light from an incandescent lamp or other low-coherence source is sent through optical fibers and a fiber-optic coupler to a reference mirror. Some of the light is also sent through the fiber optics to a lens that, in turn, focuses the light to a point that lies at or near the depth of interest in a specimen. In the fiber-optic coupler, light reflected from the reference mirror is combined with light scattered from a focal point in the specimen and is then sent along another optical fiber to a photodetector. When the length of the optical path from the light source to the mirror equals or nearly equals the corresponding mirror displacement, the photodetector puts out a

Figure 2. In a 3D OCT System, scanning in all three dimensions involves a combination of amplitude modulation, nonlinear detection, and advanced signal processing.
Benchtop Antigen Detection Technique Using Nanofiltration and Fluorescent Dyes

This technique can help to monitor the quality of water by testing for contamination at restaurants, water treatment plants, and food processing plants.

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The designed benchtop technique is primed to detect bacteria and viruses from antigenic surface marker proteins in solutions, initially water. This inclusive bio-immunoassay uniquely combines nanofiltration and near infrared (NIR) dyes conjugated to antibodies to isolate and distinguish microbial antigens, using laser excitation and spectrometric analysis. The project goals include detecting microorganisms aboard the International Space Station, space shuttle, Crew Exploration Vehicle (CEV), and human habitats on future Moon and Mars missions, ensuring astronaut safety. The technique is intended to improve and advance water contamination testing both commercially and environmentally as well. Lastly, this streamlined technique poses to greatly simplify and expedite testing of pathogens in complex matrices, such as blood, in hospital and laboratory clinics.

The approach relies on NIR fluorescent dyes derivatized to specific antigenic protein pairs left on the nanofiltration process using a portable, table-top centrifuge. The remaining NIR dye/antibody and antigenic protein pairs left on the nanofilter are transferred to cuvette, excited by an NIR laser, and detected by spectrometer. Using simple computer software, the results are easily interpreted as intensity peaks at the appropriate NIR offset wavelength emission.

Initial data reveal the assay sensitively identified antigens at intensity counts of 100 IC or higher (or roughly 36 pW) with an accuracy of 85 percent for 2-