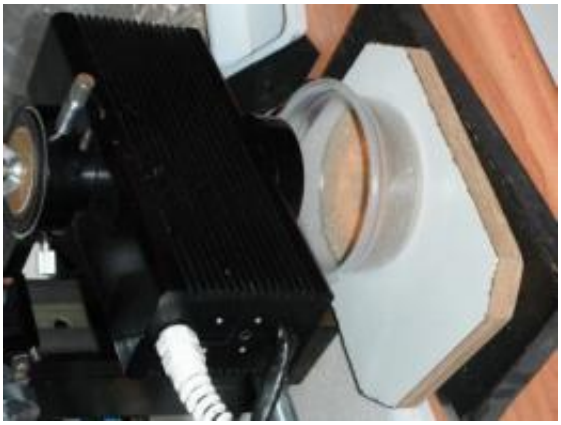
Thousand-color sensor reveals contaminants in Earth and sea

November 2 2011



This is the hyperspectral sensor in a Tel Aviv University laboratory. Credit: American Friends of Tel Aviv University (AFTAU)

The world may seem painted with endless color, but physiologically the human eye sees only three bands of light — red, green, and blue. Now a Tel Aviv University-developed technology is using colors invisible to the naked eye to analyze the world we live in. With the ability to detect more than 1,000 colors, the "hyperspectral" (HSR) camera, like Mr. Spock's sci-fi "Tricorder," is being used to "diagnose" contaminants and other environmental hazards in real time.

Prof. Eyal Ben-Dor of TAU's Department of Geography and the Human Environment says that reading this extensive spectrum of color allows the sensor to analyze 300 times more information than the human brain

can process. Small and easy to use, the sensor can provide immediate, cost-effective, and accurate monitoring of forests, urban areas, agricultural lands, harbors, or marinas — areas which are often endangered by contaminants and phenomena such as soil erosion or sediment dust. Using the hyperspectral camera will ultimately lead to better protection and treatment of the environment.

The HSR sensor, detailed in the journal *Remote Sensing of Environment*, has both commercial and scientific applications, says Prof. Ben-Dor, who has consulted for local and foreign space agencies in their use of the technology. These applications can include anything from helping companies adhere to regulations on environmental contamination to measuring the extent of environmental damage caused by forest fires.

From far and wide

The sensor interprets reflected sunlight radiation that bounces off an object, material, or environment. Each reflected color represents a different chemical reaction between two compounds. "A combination of absorption or reflection of energy creates the color that the HSR sensor sees," explains Prof. Ben-Dor. The sensor's extensive range — reading information from as close as 0.4 inches and as far as 500 miles away — means it can be placed anywhere from the ground itself to unmanned aircraft, satellites or weather balloons. The camera can also be pointed towards the stars to help astronomers gain insight into the make-up of a planet's atmosphere.

This is professor Eyal Ben-Dor of Tel Aviv University. Credit: American Friends of Tel Aviv University (AFTAU)

Most recently, Prof. Ben-Dor has used the technology to survey different environments, including soil and sea, seeking to identify problem areas. The area around gas pipelines is one site of environmental contamination, he says. Leaks can be particularly damaging to the surrounding earth, so the sensors can be used to test along a pipeline for water content, organic matter, and toxins alike. In agricultural areas, the sensor can be used to determine levels of salt in the soil to save crops before they are destroyed.

The technique is also effective in marinas, which are highly contaminated by gasoline and sealants from the undersides of sea vessels. "This toxic material sinks, and becomes concentrated on the sediment of the marina, which also contaminates nearby beaches," Prof. Ben-Dor explains.

The color of possibility

Before the HSR technology was developed, samples of potentially contaminated or endangered soil, sediment or water would have to be

taken to the lab for lengthy analysis. With the use of a hyperspectral sensor, real-time analysis allows immediate action to better environmental conditions. The sensor can also be used to determine levels of indoor pollution caused by dust, analyze the strength of concrete being used for buildings in earthquake zones, or scan the environment around an open mine to look at the impact on human health.

According to Prof. Ben-Dor, this technology's potential is endless and can be used in disciplines such as medicine, pharmacology, textile industry, and civil engineering. Without so much as a touch, the sensor can provide in-depth analysis on environmental composition. It's a method that can map and monitor the earth from "microscope to telescope," he says.

Provided by Tel Aviv University