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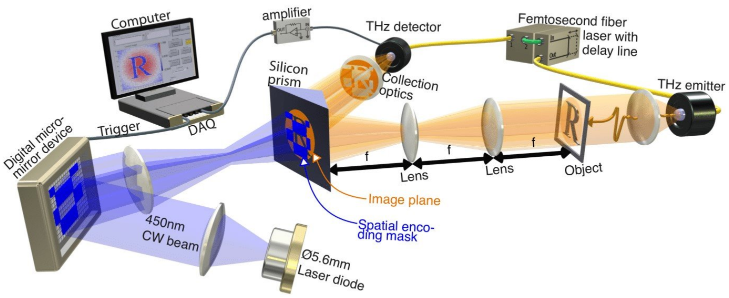
China develops T-ray camera for non-invasive medical screening

14 July 2020 | News

The technique utilizes terahertz radiation, or T-rays, that sit in-between infrared and WiFi on the electromagnetic spectrum



Scientists from The Chinese University of Hong Kong (CUHK) and University of Warwick have refined a new type of camera to make it a hundred times faster than the previous state of the art.

Scientists are a step closer to developing a fast and cost-effective camera that utilizes terahertz radiation, potentially opening the opportunity for them to be used in non-invasive security and medical screening.

A research team led by Professor Emma Pickwell-Macpherson from the Electronic Engineering Department and University of Warwick Department of Physics, and involving Rayko Ivanov Stantchev and scientists from the Department of Electronic Engineering at CUHK has reached a crucial milestone towards developing single-pixel terahertz imaging technology for use in biomedical and industrial applications.

Their single-pixel terahertz camera reached 100 times faster acquisition than the previous state-of-theart without adding any significant costs to the entire system or sacrificing the sub-picosecond temporal resolution needed for the most sought-after applications. The breakthrough has been published in the journal *Nature Communications.*

Terahertz (THz) radiation, or T-rays, sit in-between infrared and WiFi on the electromagnetic spectrum. T-rays have different properties from other electromagnetic waves, most notably they can see through many common materials such as plastics, ceramics and clothes, making them potentially useful in noninvasive inspections. Another quality is that the low-energy photons of T-rays are non-ionizing, making them very safe in biological settings including security and medical screening. They are also highly sensitive to water and can observe minute changes to the hydration state of biological matter. This means that diseases perturbing the water content of biological matter, such as skin cancer, can potentially be detected using T-rays in vivo without any histological markers.

For biomedical applications, very few clinical trials have been performed most notably due to the equipment not being user-friendly and imaging being too slow due to the need for measuring multiple terahertz frequencies (for accurate diagnosis). Finally, equipment and running costs need to be within hospital budgets. As a result, a lot of research into terahertz technology is currently focused on developing the equipment to improve imaging speed, without reducing diagnosis accuracy or incurring large costs. As a result, we have to explore alternative imaging techniques to those currently used in modern-day smartphones.

Images captured by this single-pixel camera via spatially modulating the THz beam and shining this light onto an object.

Then, using a single-element detector, one can record the light that is transmitted (or reflected) through the object planed to image.

***Image Caption**: Optical set up for single pixel transmission imaging of object R.*