



## New mid-infrared spectroscopy technique highlighted in Optica

Mid-Infrared light source developed at ICFO enables the generation of tunable mid-IR radiation and image upconversion for higher resolution imaging of fast events

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ICFO researchers, Dr. Chaitanya Kumar and ICREA Prof at ICFO Majid Ebrahim-Zadeh, in collaboration with researches from DTU Fotonik, Exeter University, and Gloucestershire Hospital NHS Foundation Trust, have recently published results in Optica of a study which details a new approach to capture detailed mid-IR images for medical diagnostics.

The researchers drew on a process known as nonlinear frequency conversion in which energy is added to a photon to change its wavelength, and hence its colour. Although frequency conversion, or upconversion, is often used to change the wavelength of a laser's output, the researchers from DTU Fotonik developed a detection system that could shift an entire mid-IR image into the near-IR wavelength range while preserving all the spatial information.

The system incorporates a new mid-IR light source, a picosecond optical parametric oscillator (OPO), developed at ICFO. This discrete-wavelength light source can be tuned to different wavelengths and it uses parametric frequency conversion to generate the mid-IR light. In fact, the researchers used the same pulsed near-IR OPO for two things: to generate the tunable mid-IR light, and to achieve the image upconversion.

The researchers demonstrated the imaging speed of their new mid-IR upconversion spectroscopy approach by tuning the illumination laser to match the peak absorption of a gas flow and acquiring a video with 40 images per second.

In addition, researchers from Exeter University conducted a pilot study in which the system was used to evaluate cancerous and healthy esophageal tissue samples. They found that morphology and spectral classification using their system matched well with the standard stained histopathology images.