COMPRESSIVE IMAGING IN LASER SPECTROSCOPY

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Compressive imaging denotes a range novel methods used for image acquisition, which allows us to redesign the concept of imaging and use unconventional experimental setups. The methods are based on compressed sensing – a mathematical theory enabling us to recover sparse datasets from a highly reduced number of measurements.

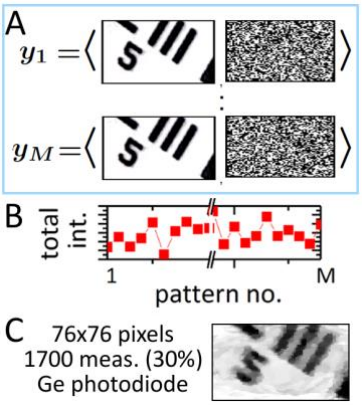

Fig. 1. Projection via random masks (A) enables efficient image acquisition for SPC. A dataset of total intensities (B) together with random masks is used to reconstruct measured image – see an example (C) for an USAF target (area 1.75×1mm) measured by a pair of balanced Ge photodiodes (IR imaging).

An example of such method is the so-called single-pixel camera. In this experiment, an image is encoded by a series of random patterns (see Fig. 1A) and subsequent detection of the total light intensity for each pattern (see Fig 1B) is sufficient to exactly recover the image (see Fig. 1C). This field is, in particular, promising for imaging in the non-conventional spectral ranges, such as mid-infrared or THz region.

We will present a brief overview of the methods currently utilizing compressed sensing in laser spectroscopy. The main part will be devoted to experiments exploiting coherence of laser light, namely the so-called laser speckles, which can serve as a random pattern encoding the information in the single-pixel camera experiment. By using this concept, we have constructed a lens-less photoluminescence (PL) hyperspectral camera able to capture PL image in a broad range of wavelengths. We will, furthermore, demonstrate that the same approach can be used in ultrafast spectroscopy (pump-probe technique) to attain imaging setup with temporal resolution below 50 fs.

In general, the presented use of laser speckles for image encoding has a great potential to implement imaging onto the commonly-used spectroscopic experimental setups.