

Project Title:

# Coherent Excitation Coding for Exploitation of Compressed Sensing in Laser Spectroscopy

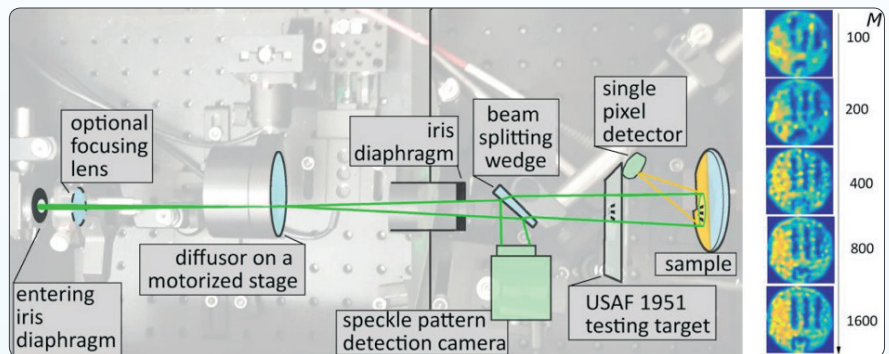
Compressive sampling represents a new approach to data acquisition. It exploits the fact that many of the commonly measured datasets are sparse, i.e. they can be expressed by only a few significant components in a well chosen basis. A typical example is a photograph, where a huge amount of information can be compressed via wavelet transformation into a small datafile (JPEG2000). Compressive sampling makes it possible to devise unconventional solutions to many problems, including imaging in 'exotic' spectral areas.

Methods based on compressed sensing rely on encoding the acquired information (an image) by a series of random patterns. We are investigating the possibility of performing image encoding via laser speckle patterns generated by an excitation laser beam scattered on a diffusor. The random speckle pattern arises due to random interference of many wavefronts. The presented approach makes it possible to carry out imaging for a broad range of coherent excitation sources and detection spectral areas with a minimum number of optical elements. The newly developed methods can be used for effective studying of materials and physical processes via laser spectroscopy. Such application of compressive imaging (e.g. using a single-pixel camera) allows us to devise experimental imaging setups for spectral ranges which cannot be reached by conventional imaging detectors.

## Project outcomes

Žídek, K., Denk, O. and Hlubuček, J., 2017. Lensless Photoluminescence Hyperspectral Camera Employing Random Speckle Patterns. *Scientific reports*, 7(1), p.15309.

Žídek, K., Hlubuček, J. and Denk, O., 2017. Random Image Encoding via Speckle Pattern: The Effect of Patterns Correlation. In *3D Image Acquisition and Display: Technology, Perception and Applications* (pp. JTU5A-1). Optical Society of America.



## International collaboration

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Within this collaboration we are mainly investigating options of employing coherent excitation coding in ultrafast spectroscopy, which enables tracking processes in materials on the timescale of several femtoseconds (1 fs = 10<sup>-15</sup> s). This collaboration has also been supported by Laserlab-Europe.