MASTER: Machine learning for single-pixel video recovery

CREATIS opens a Master internship of 5-6 months to address new questions in the emerging field of fast single-pixel video recovery

Keywords   Single-pixel imaging, compressive video acquisition, machine learning, learning to rank, representation learning.

Background   Recent advances in signal processing have made it possible to design new digital imaging systems. Single-pixel imaging is a new paradigm that enables two-dimensional imaging from a point detector. It has raised increasing attention because it allows high-performance optical imaging systems (e.g., hyperspectral and/or time-resolved) to be developed at very low cost [1]. Single-pixel cameras comprise a single point detector that is coupled with a spatial light modulator. By performing a sequence of optical measurements for different modulation patterns, it is possible to recover the image of the observed scene provided that *ad-hoc* restoration algorithms are implemented. Our group recently showed that adapting the patterns to the object can lead to a significant increase of both image acquisition and recovery [2-3].

Work Plan   We intent to benefit from the high capacity of machine learning methods to extract useful knowledge from the data to determine the best modulation patterns that should be acquired in a particular time frame, and also across multiple time frames. Video recovery will be formalised as a learning to rank problem [4] where the order of mask patterns used during image acquisition will be provided by the learning algorithm. Depending on the advances of this process, we may also consider learning the appropriate mask patterns based on the representation learning algorithms, rather than choosing patterns within a predetermined basis.

Context   The expected duration of the internship is 5-6 months. The internship is supported by an ANR JCJC grant. A PhD position will be open in October 2018.

Skills   We are looking for a student with a background in image processing, computer science and/or machine learning. Knowledge in optics would be appreciated but is not mandatory. Strong programming skills in one of the following languages is required: Matlab, Python.

Salary   ~600€ net monthly

How to apply?

Send your CV, a motivation letter, and your academic records to

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Reference   [1] R. G. Baraniuk *et al.*, "Compressive video sensing: Algorithms, architectures, and applications", *IEEE Signal Processing Magazine*, 34 (1), 52-66, 2017.
[2] F. Rousset *et al.* "Adaptive basis scan by wavelet prediction for single-pixel imaging", *IEEE Transactions on Computational Imaging*, 3 (1), 36-46, 2017. Open access pdf.
[3] https://www.creatis.insa-lyon.fr/~ducros/WebPage/single_pixel_imaging.html
[4] Tie-Yan Liu, "Learning to Rank for Information Retrieval", Foundations and Trends in Information Retrieval, Foundations and Trends in Information Retrieval, 3 (3): 225–331, 2009.