EPFL

EPFL-TTO
EPFL Innovation Park J
CH-1015 Lausanne
Switzerland
+41 21 693 70 23
http://tto.epfl.ch/

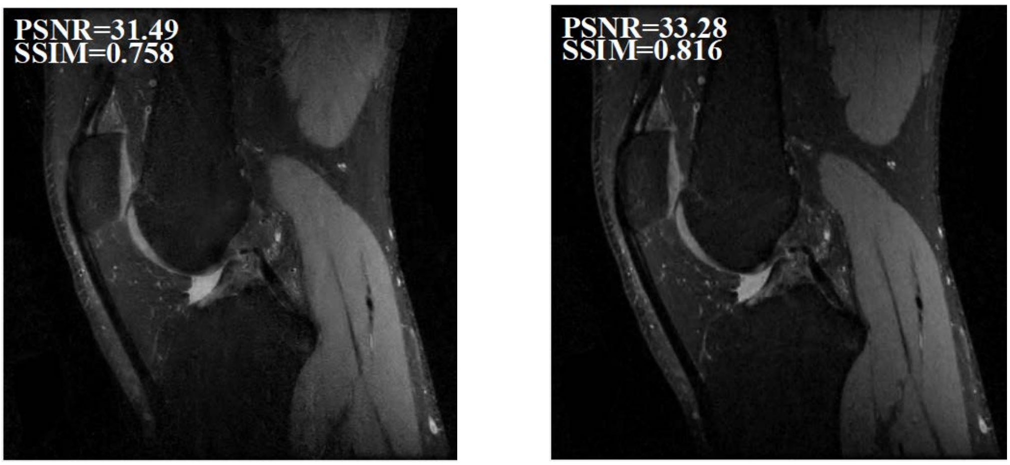
Research Contact
Prof. Volkan Cevher
+41 21 693 1101
volkan.cevher@epfl.ch

TTO Contact
Dr. Frédéric Pont
+41 21 693 1309
frederic.pont@epfl.ch

Licensing Opportunity

TTO – Technology Transfer Office

Learning Based Subsampling



(a) State-of-the-art (b) Learning based

Figure 1. Learning-based sampling outperforms the state-of-the-art sampling in terms of visual quality, PSNR (peak signal-to-noise) and SSIM (structural similarity), on a knee that is scanned with 6 times acceleration.

Ref. Nr

6.1542

Keywords

Compressive sensing, data-driven sensing design, signal subsampling, scientific and medical imaging

Intellectual Property

Cevher et al., US10082551B2 granted

Publications

"Learning-Based Compressive Subsampling," in IEEE Journal of Selected Topics in Signal Processing, vol. 10, no. 4, pp. 809-822, June 2016.

Description

Recent advances in compressive sensing techniques exploit the structured sparsity of signals to allow a significant reduction in sampling rates. However, current schemes revolve around randomized sampling, often impractically requiring parameters to be tuned on a case-by-case basis. The present invention instead finds fixed near-optimal sampling strategies, and avoids randomization and parameter tuning. It is especially powerful in applications that require the sampling of similar signals repeatedly, leading to enhanced reconstruction and improved compression rates as compared to alternative methods.

This invention provides a data-driven approach to performing subsampling in compressive measurement systems, in which a fixed index set is chosen based on a set of known training signals. These indices are the solution of a combinatorial optimization problem, which aims to capture as much information in the training signals as possible in an average-case or worst-case sense. The particular structure of the problem allows approximate or exact solutions to be obtained efficiently.

Advantages

This method of subsampling is an example of a modern compressive sensing system which exploits structure in objects to reduce the number of samples required for reconstruction. It is, however, so far the only method that can adapt to a specific class of objects whilst producing sharper image reconstruction. In Magnetic Resonance Imaging (MRI) applications where images of the same object are sought repeatedly, subject to small changes, this invention quickly adapts to the specific structure of the object and efficiently reconstructs images given the same number of samples as in other methods. Importantly, this allows for a significant reduction in scan time without compromising image quality.

Another advantage of the method lies in the fact that it directly adapts to different reconstruction algorithms and setups such as single/multicoil and static/dynamic MRI. That is, it can produce near-optimal sampling schemes for specific settings. These schemes, when combined with the reconstruction algorithms they are optimized for, then boost the image quality for fast MRI scans.

Applications

- Magnetic Resonance Imaging (MRI)