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Investigation on Compressed Sensing concepts

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Ph.D. Topic - MSCA Doctoral Networks USES2 – DC03: Efficient sensor data acquisition via compressed sensing for autonomous sensor applications
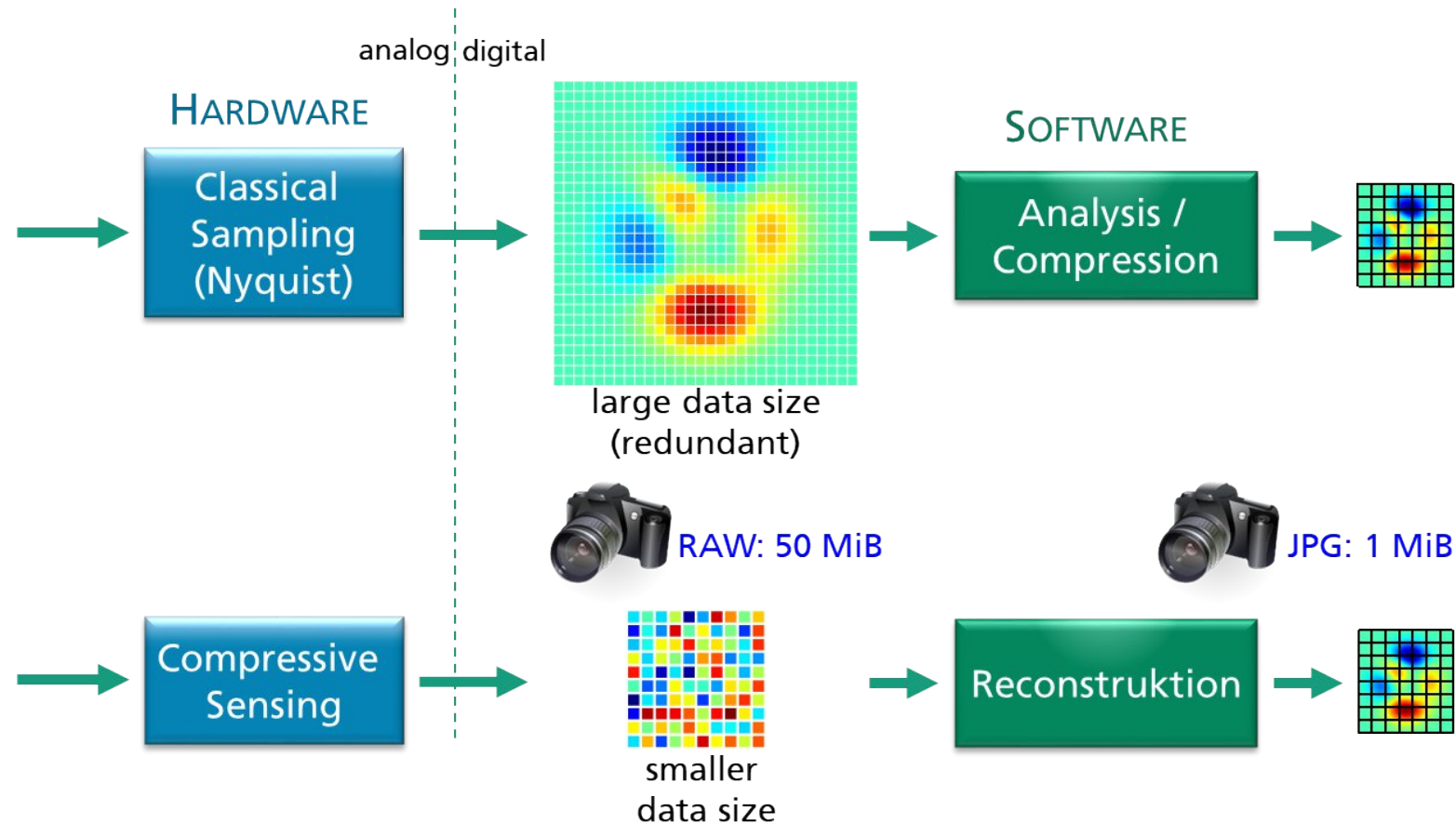

Figure 1. Procession of traditional compression vs CS
Image source Fraunhofer IZFP

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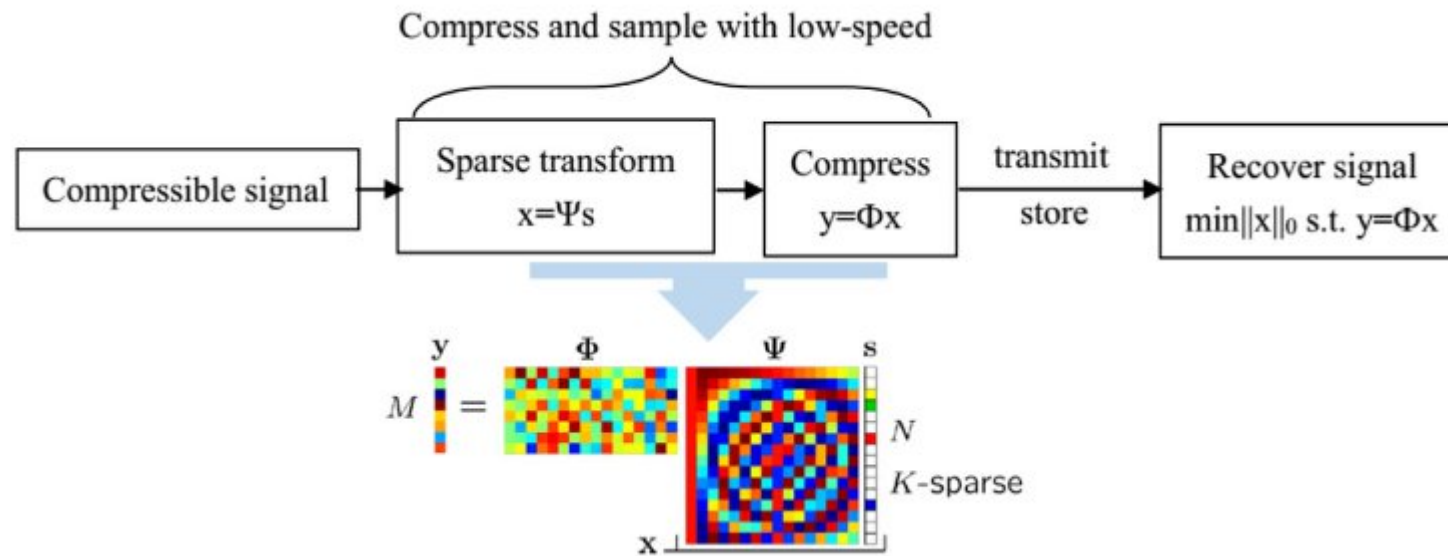

Figure 2. Framework of compressed sensing

Jie, Y., Guo, C., Li, M. and Feng, B., 2018. Construction of compressed sensing matrices for signal processing. *Multimedia Tools and Applications*, 77, pp.30551-30574.
Construction of compressed sensing matrices for signal processing | Multimedia Tools and Applications (springer.com)

Ph.D. Objective - MSCA Doctoral Networks USES2 - DC03: Efficient sensor data acquisition via compressed sensing for autonomous sensor applications

- We are conducting research as a part of a consortium where the principle is <u>looking for data reduction methods</u> for acoustic and ultrasonic sensors.

- The crucial question now arises: <u>which measurements are important</u>, and how often should these measurements be taken. The correct balance creates robust and stable reconstruction with optimizing the data acquisition.

- The aim of our project <u>is to achieve effective Signal reconstruction from fewer measurements</u>.

- Research Aims and Hypothesis
  - The issue of the reconstruction is very challenging. In worst case scenario, the computational cost can be so high that it may cancel the advantages of the low sampling rates, making the CS approach pointless. <u>The principle idea of this study to reduce CS computational complexity without compromising the reconstruction quality</u>. The signal reconstruction problem can be reformulated to achieve this efficient complexity.

Joint Work with DC05

- **We have received 2 datasets from BAM**
  - 218_11_01_2024 polyamide data
 - 267_16_02_2024 concrete data

- **Current Status**
  - FISTA and OMP are used.
  - Dictionary learning :

  Sparse dictionary learning (also known as sparse coding or SDL) is a representation learning method which aims at finding a sparse representation of the input data in the form of a linear combination of basic elements as well as those basic elements themselves.

- **Straight Forward**
  - Apply Compression + Reconstruction .
  - Start building a CS framework.
  - Compare performance.
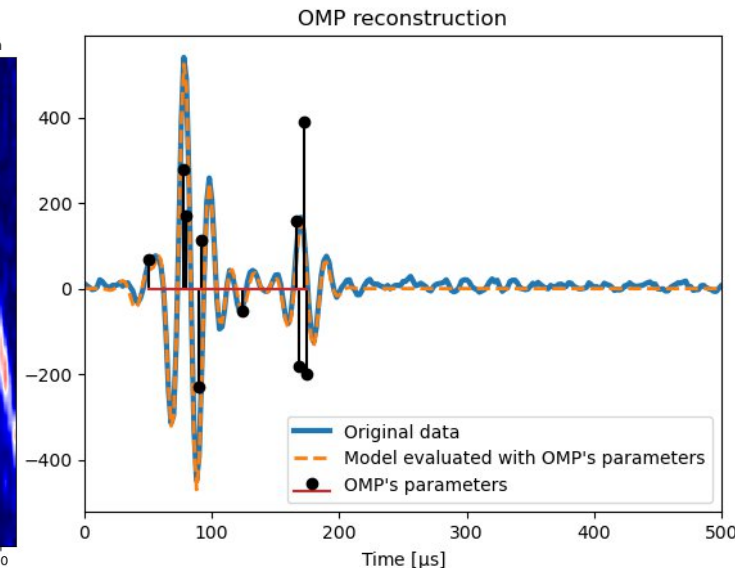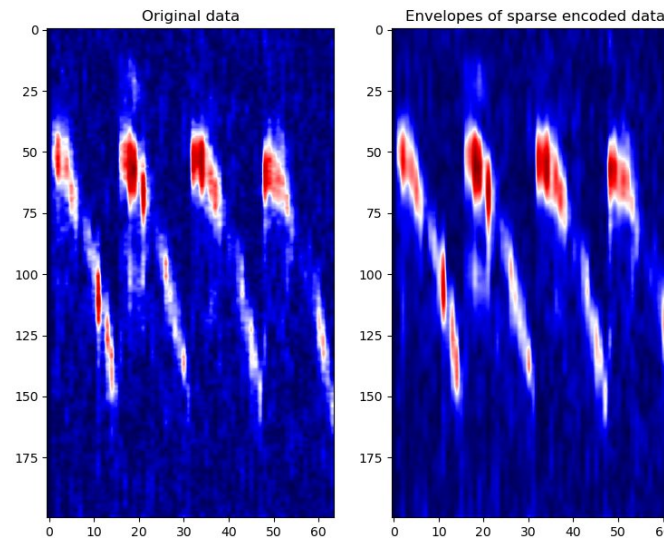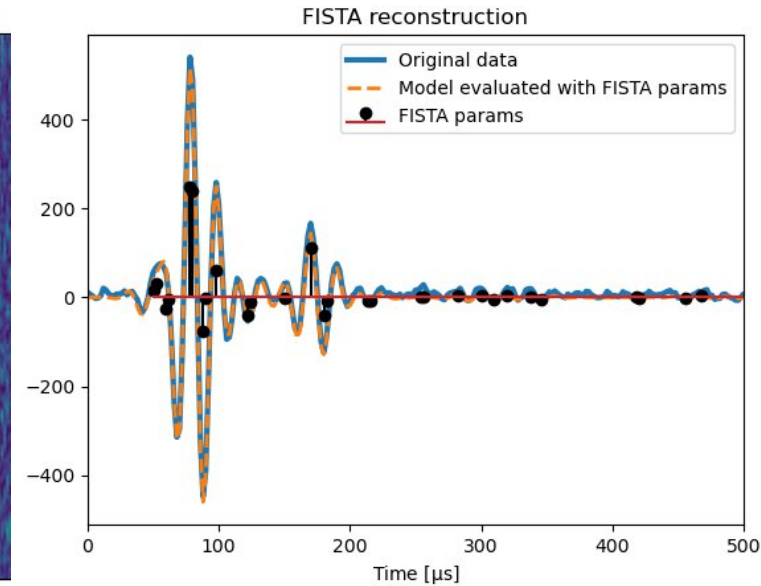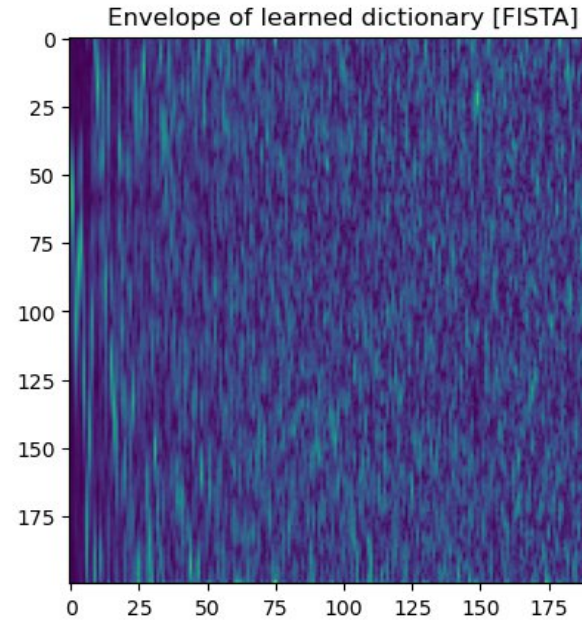
Upcoming Joint Work with DC07

- **We have received 1 datasets from UGE**
  - CWI +NCWI data

- **Current Status**
  - -

- **Straight Forward**
  - to be investigated more during the secondment
  - Understand how the data are acquired.
  - Conducting a joint laboratory experiment to collect additional data.
  - Understand how the CWI data is processed, step by step.
  - Start to define more clearly the relevant part of the signal in the light of the actual CWI task, define an appropriate metric to measure success.
  - Start building a CS framework.
  - Compare performance.
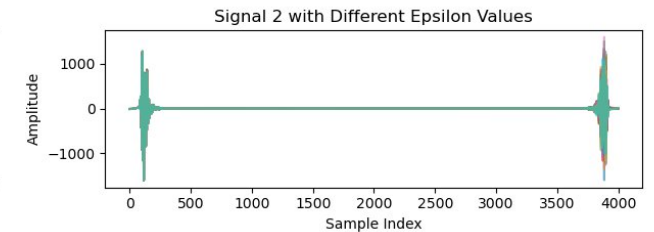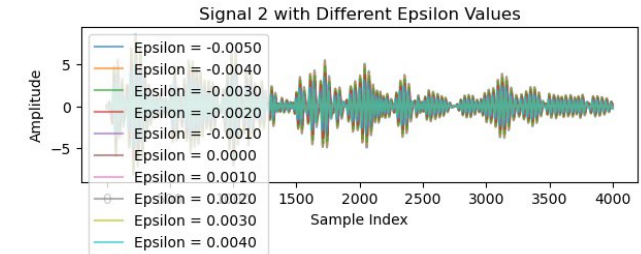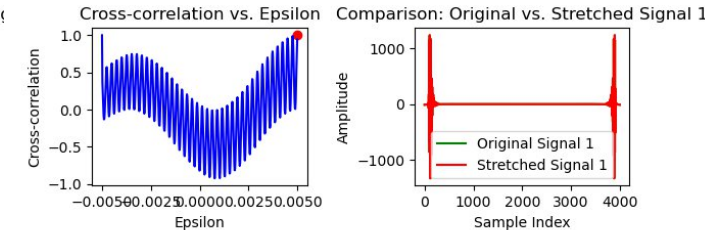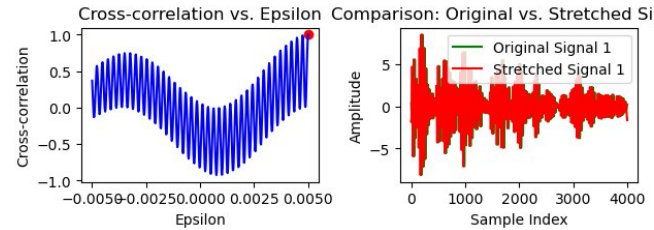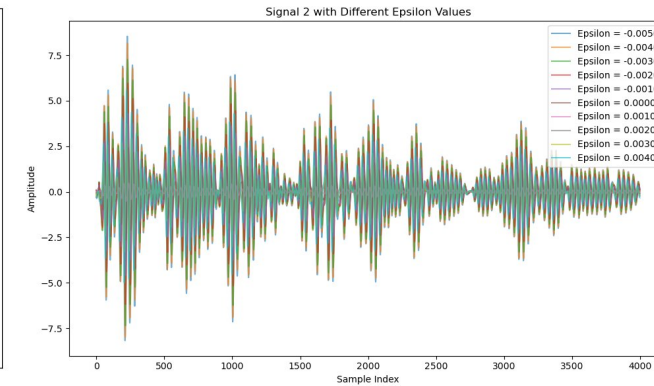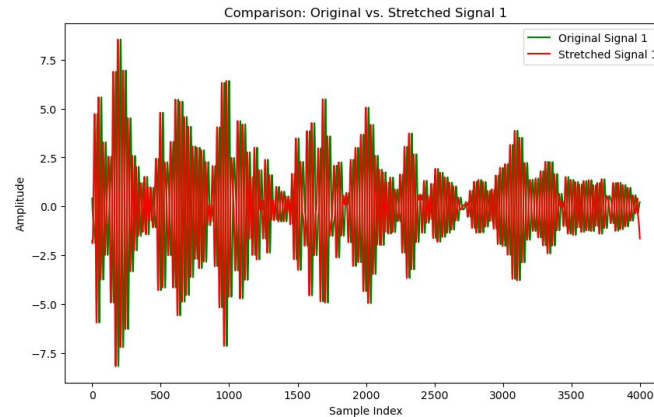
Thank you for your attention

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