Master/Bachelor Thesis:

Bad data detection in Mtdc grid using compressed sensing methodology

Context:

In the recent times, there has been a resurgence of DC technology due to development in power electronics converter and penetration of renewable energy in the electrical distribution grid. Among the various developments in the DC technology, one of the areas of development is the integration of DC electrical grid with the AC electrical grid, hence leading to hybrid AC/DC grids, where the AC and DC grids share common nodes connected by bidirectional converters. The hybrid AC/DC grids requires a monitoring platform which needs to be robust to reduce noise and avoid bad data. Currently, there are bad data detection methods present such as Chi-square and Normalized residual but they are unable to detect the error accurately in the measurements. Hence in the thesis, we would like to see the application of compressed sensing for the monitoring system.

The field of compressive sensing is an area of active interest in the past 15 years, since it offers a methodology for reconstruction of a signal without following Nyquist–Shannon sampling theorem according to which the signal's highest frequency should be less than half of the sampling rate for faithful reconstruction. Although compressive sensing seems an obvious choice for reconstruction of the measurements, there are a few inherent pre-conditions, which hinder the implementation of compressed sensing. Compressed sensing demands the measurement signal to be ''sparsely represented'' using a transform (wavelet transform or Fourier transform) which extracts the transform coefficients from the measurement signal. The sparse signal is reconstructed at the control center.

The monitoring system should use compressed sensing to faithfully reconstruct the measurement signals at the control center. The advantages of using compressed sensing are as follows

- The measuring instrument does not need a high sampling rate
- Smaller measurement data packets needs to be sent to the control center, hence reducing the data traffic to the control center
- Compressed sensing has an inherent encryption attached to the algorithm

Your tasks:
The major tasks involved in the thesis are as tabulated below.

- A comparative study of different transform functions for sparsely representing an AC and a DC signal
    - Comparative study of the error of the original signal from the regenerated signal for different transform methodologies
    - Comparison of the maximum extent of sparsity for different transform methodologies
    - The computational complexity for the transform methodology
    - The extent of dynamics which the measurement signal can faithfully reconstruct
- Implementation of compressive sensing on an existing monitoring platform

At the beginning, the student should look into the methodologies for the transform, and where the different types of transform libraries are present in MATLAB . A comparative study with the monitoring platform should be carried out in MATLAB.

Profile:
We are looking for students with a knowledge of MATLAB. A knowledge of signal processing is an advantage.

Contact:

Gaurav kumar roy
Tel. +49-241-80-49473
GRoy@eonerc.rwth-aachen.de

ACS | Institute for Automation of Complex Power Systems
ERC | E.ON Energy Research Center
RWTH Aachen University
Mathieustr. 6, 52074 Aachen, Germany

Abhinav Sadu
Tel. +49-241-80-49473
asadu@eonerc.rwth-aachen.de

ACS | Institute for Automation of Complex Power Systems
ERC | E.ON Energy Research Center
RWTH Aachen University
Mathieustr. 6, 52074 Aachen, Germany