

## **COURSE TITLE: SPARSE REPRESENTATION AND COMPRESSIVE SENSING IN SIGNAL AND IMAGE PROCESSING**

### **OUTLINE:**

This course will cover the mathematical theories of sparse representation and compressive sensing, which is a new, contemporary, vastly growing field in statistical signal processing, and, will discuss, how these are utilized in solving several types of signal processing and image processing problems. The area of compressive sensing relies on the observation that many types of signals and images can be represented by a sparse approximation in terms of a suitable basis and this representation can be successfully carried out using a small number of non-zero coefficients. The course will begin with discussions about underdetermined linear systems, sparse solutions of linear systems, and importance of minimization of  $l_0$  norm and  $l_1$  norm in this regard. In the next part, the course will discuss about the pursuit algorithms, the iterative shrinkage algorithms and so on. This will be followed by discussions on sparse representation based classification and collaborative representation based classification and their variants. In the next part, the course will discuss about dictionary learning algorithms e.g. K-SVD algorithm, MOD algorithm etc. Next, the course will discuss about the salient features of compressive sensing algorithm, with discussions on how stable measurement matrices can be designed, with suitable design of reconstruction algorithms in conjunction with these. Finally, the entire course will discuss, at relevant points, how these algorithms can be readily applied to solve a large class of problems in the areas of signal processing, image processing, and pattern recognition.

Lectures will be taught in English, from November 06, 2017 to November 10, 2017, each day for five hours (10:00 to 12:30 Hrs and 13:30 to 16:00 Hrs) with the following daily schedule:

- Monday, November 06, 2017: Introduction to underdetermined linear systems, sparse solutions of linear systems, importance of minimization of  $l_0$  norm and  $l_1$  norm.
- Tuesday, November 07, 2017: Pursuit algorithms, Iterative Shrinkage algorithms. Applications in image processing and signal processing problems.
- Wednesday, November 08, 2017: Sparse representation based classification (SRC), Collaborative Representation based Classification (CRC), patch based CRC (PCRC), multiscale patch

based CRC (MSPCRC). Applications in image processing and signal processing problems.

- Thursday, November 09, 2017: Dictionary Learning algorithms: K-SVD algorithm, MOD algorithm etc. Applications in image processing and signal processing problems.
- Friday, November 10, 2017: Compressive Sensing algorithm: Sensing matrices, stable measurement matrix, Reconstruction algorithms. Applications in image processing and signal processing problems.

In addition, there will be two Seminars delivered at LiSSi Lab, with the following title and schedule:

- Seminar 1: “Sparse And Collaborative Representation for Solving Biometric Problems”  
(Date: Wednesday, November 22, 2017.  
Time: 10:00 to 12:30 Hrs)
- Seminar 2: “Compressive Sensing for Medical Imaging Applications”  
(Date: Thursday, November 23, 2017.
- Time: 10:00 to 12:30 Hrs)