Course Code	Course Title	L	T	P	C
1156EC418	SPARSE REPRESENTATION IN IMAGE PROCESSING	0	0	0	2

a) Course Category

Independent Learning – Self learning course

b) Preamble

Handling and description of information in Image processing requires modeling. Sparse representation is basically a model where data is represented as a linear combination of blocks from a pre-defined dictionary of such fundamental elements. This course gives an insight into the fundamentals of sparse representation and the different algorithms used for Sparse representation techniques

c) Prerequisite

Nil

d) Related Courses

Digital Image Processing

e) Course Outcomes

Upon the successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the fundamental concepts of sparse representation and its properties.	K2
CO2	Discuss the theoretical analysis of sparse representation techniques.	K2
CO3	Describe Greedy Pursuit Algorithms and Thresholding algorithm for sparse representation.	K2
CO4	Explain the approximate solutions for sparse representations.	K2
CO5	Describe the properties used for the analysis of Pursuit algorithms.	K2

f) Course Content

UNIT I FUNDAMENTALS OF SPARSE REPRESENTATION

Introduction to sparse and redundant representations-Basis and frames, underdetermined linear systems, regularization techniques and convexity, L1 minimization, L0 norm and P0 problem

UNIT II THEORETICAL ANALYSIS OF SPARSE REPRESENTATION

The Two-Ortho Case, Uncertainty Principle, From Uncertainty to Uniqueness, Introduction to Spark, Uniqueness for the General Case via the Spark, Uniqueness via the Mutual-Coherence, Uniqueness via the Babel-Function

UNIT III GREEDY PURSUIT ALGORITHMS

Pursuit algorithms in practice: Matching pursuit, Orthogonal matching pursuit (OMP), Stage-wise orthogonal matching pursuit, Regularized orthogonal matching pursuit (ROMP); Compressive sampling matching pursuit (CoSaMP); Thresholding (THR) algorithm

UNIT IV APPROXIMATE SPARSE SOLUTION

OMP and Basis Pursuit(BP) algorithm extensions, Iterative reweighted least squares (IRLS) algorithm; iterative shrinkage algorithms, IRLS solution of the BP algorithm

UNIT V ANALYSIS OF PURSUIT ALGORITHMS

Uniqueness, Stability, Restricted Isometry Property, Performance of Pursuit Algorithms, Basis Pursuit stability guarantee, Thresholding stability guarantee, OMP stability guarantee

g) Learning Resources

References

1. https://www.edx.org/course/sparse-representations-signal-image-israelx-236862-1x
2. https://www.edx.org/course/sparse-representations-image-processing-israelx-236862-2x
3. https://lear.inrialpes.fr/people/mairal/tutorial_iccv09/