Nonlinear and Data-Adaptive Signal Analysis Techniques and Applications

Course Title	Nonlinear and Data-Adaptive Signal Analysis Techniques and Applications
Course Category	Specialized Skills / Research
Relevant Discipline(s)	All branches of Science and Engineering, Earth Sciences and Climate Studies
Duration of course in equivalent integer no. of days (min 3 days, 1 day = 6 hrs of lectures/hands on sessions)	4 days (i.e., 8 half-days @ of 4 hours per day), spread over two weeks.
Proposed dates	January 15-17 (Fri-Sun) 2021 and January 22-24 (Fri-Sun) 2021

Brief Course Description and Course Contents

General information:

1. This course essentially highlights the application of different nonlinear techniques on various nonlinear signals.
2. The theory and tutorials of the entire course will be conducted in online mode.
3. The course will have 4 contact hours per day @ 2 hours each of theory and tutorial.
4. Participants must have their own laptops with pre-installed suitable programming compilers/ softwares to do the computations during tutorial sessions.

Pre-requisites:

1. Knowledge of signals and systems, mathematics and statistics is desirable
2. Participants must have knowledge of coding in MATLAB, Python or C/C++/C# or any other programming language.

Course Contents:

Theory: Introduction to Wavelets; Continuous and Discrete wavelet transformation of nonlinear signals; Introduction to data-adaptive techniques; Maximum Entropy Method of data analysis; Theory of Fractals and Multifractals; Role of Fractals and multifractals in time series analysis; Different fractal and multifractal analysis techniques and determination of scaling exponents; Multifractal analysis of nonlinear signals; multifractal singularity spectrum; Wavelet-based multifractal analysis; Introduction to Hilbert-Huang transform; Empirical mode decomposition (EMD) analysis; Estimation of instantaneous amplitude, instantaneous phase and instantaneous frequency from nonlinear signals using Hilbert spectral analysis (HSA); Applications of the above techniques on a variety of naturally produced nonlinear signals.

Tutorials: Participants will be provided some test data sets and will be asked to develop their own codes to do some computations to have a hands-on experience on the analysis of nonlinear data using the above techniques.

Instructor Details			
S. No.	**Name of the Instructor**	**Department**	**Email**
1.	Prof. E. Chandrasekhar	Earth Sciences	esekhar@iitb.ac.in