Fractal Geometry : Foundations to Frontiers

Overview

The course is to provide the student with a profound knowledge of the foundations of fractal geometry and with tools to apply the theoretical concepts to real-world applications. The course content supplements and complements courses in geometry, analysis, and probability theory. It enables the participants to employ new and powerful methods to describe and model complex phenomena. Beginning with a definition of fractal, the concepts of topological and metric dimension are introduced, discussed, and set into perspective with fractals and their properties. Iterated function systems (IFSs) are defined and several of their properties considered. Formulae for the Hausdorff and box dimension for a class of iterated function systems are presented. It is also shown how the box dimension of fractals can be computed numerically. The important concept of code space associated with an iterated function system is introduced next. Fractal transformations are briefly considered and conditions under which two fractals are homeomorphic are given. Iterated function systems with probabilities and their properties are presented next. In this connection, the concept of fractal or IFS-invariant measure is introduced. Fractal interpolants will be introduced and applications to approximation and interpolation theory, image and data compression are highlighted. The final focus lies on V-variable fractals and superfractals. Both are recent additions to fractal geometry and the focus of current research. Superfractals can be viewed as attractors of a so-called superIFSs, i.e., IFSs whose mappings are themselves IFSs. The points of superfractals are so-called V-variable fractal sets, where V is a parameter describing the variability of shapes or forms encountered in the geometric structure of these fractals. V-variable fractals have the potential to be employed for modeling purposes and for geometric applications that require random fractals with a controlled degree of strict self-similarity at each scale. The recent development on data visualization by rational fractal functions will be discussed in order to show its application in computer graphics and CAGD.

Course participants will learn these topics through lectures, assignments, and self-studies. After the successful completion of the course, the participant will be able to apply fractal methodologies, in particular fractal interpolation and superfractals, to numerous problems arising in areas such as geometry, analysis, approximation and interpolation theory, probability theory, complex analysis, physics, computer graphics, engineering design and CAGD and will have gained a deep understanding of fractal sets and self-referentiality.

Dates for the Course	**14th August, 2017 to 31st August, 2017**
Host Institute	**IIT Madras**
No. of Credits	**2**
Maximum No. of Participants	**40**
You Should Attend If you are	▪ A mathematician interested in to use the modern non-linear tools such as fractals and Chaos in interpolation and approximation problems. ▪ An engineering 2nd/3rd/4th year student interested to apply fractals in project or research. ▪ A student or scientist/faculty from an academic institution interested in fractals ▪ Working in industry with Image-signal processing work, CAD, CAGD, computer graphics.
Course Registration Fees	The participation fees for taking the course is as follows: **Student Participants:** Rs. 2000 **Faculty Participants:** Rs 2000 **Government Research Organization Participants**: Rs. 3000 **Industry Participants:** Rs.3000 The above fee is towards participation in the course, the course material, computer use for tutorials and assignments, and laboratory equipment usage charges. **Mode of payment: Demand draft in favour of "Registrar, IIT Madras" payable at Chennai**. The demand draft is to be sent to the Course Coordinator at the address given below.
Accommodation	The participants may be provided with hostel accommodation, depending on availability, on payment basis. Request for hostel accommodation may be submitted through the link: http://hosteldine.iitm.ac.in/iitmhostel/

Course Faculty

PD Dr. Peter Massopust is a member of the mathematics faculty at the Technical University of Munich, Germany. His research interests include fractal geometry, harmonic analysis, splines, and approximation and interpolation theory. He worked in academia, research laboratories, and industry, and published two research monographs and one textbook on fractals, splines and wavelets. He is applying methods from fractal geometry and non-commutative geometry to obtain efficient representations for multidimensional signals and images. These methods include sparse and random algorithms for the analysis of big data.

https://www-m15.ma.tum.de/Allgemeines/PeterMassopust

Dr. Arya Kumar Bedabrata Chand is an Associate Professor of Indian Institute of Technology, Madras. His research interests are Fractal Functions, Fractal Approximation, Wavelets and Computer Aided Geometric Design. He works on theory and applications of smooth or non-smooth fractal interpolation functions. Recently, his research group has introduced shape preserving fractal splines/surfaces that can be used in computer graphics, engineering design, CAD/CAM.

Course Coordinator

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