

# FRACTAL GEOMETRIC MEASURE THEORY AND APPLICATIONS

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## Overview

Fractals are non-regular geometric shapes which exhibit similar kind of non-regularity on all scales. That is, we use fractals to describe objects or phenomena in which some sort of scale invariance exists. The study of the geometry of fractals helps us to get a better understanding of many seemingly different phenomena in natural sciences and finance. Some examples of natural fractal objects are bronchial trees in mammals, growth pattern of trees, bacteria and cancer, river networks, mountain ranges, formation of dendritic copper crystals, fractals in allometry. Applications of fractal concepts to the study of complex systems include image analysis and compression, multifractal signal analysis, scaling topology of the Internet and WWW, fractal aviation and communication networks. In everyday life, we find fractals very frequently; for example, the shape of the coastlines, the shapes of the pebbles on the beaches, the blood vessels in a human body or the shape of the surface of metals when we magnify them with a microscope. Also, the mathematics of fractals can help in the prediction of stock market shifts.

The fractal sets have conspicuously different geometry from the sets - we usually study in Euclidean geometry. To understand the geometry of fractals, we need to acquire a piece of special knowledge in geometric measure theory and then we need to consider some examples of fractals and learn how the tools of geometric measure theory can be used to get a better understanding of the geometry of these fractals sets under consideration. Finally, we mention some real-life applications of these methods. After the successful completion of the course, the participants will be able to classify and analyze various non-linear phenomena and complex structure in sciences and engineering through fractal dimensions. Also, they will have gained a deep understanding of fractal sets through measure theory.

<b>Dates for the Course</b>	<b>7<sup>th</sup> December, 2023 to 22<sup>nd</sup> December, 2023.</b>
<b>Host Institute</b>	<b>IIT Madras</b>
<b>No. of Credits</b>	<b>2</b>
<b>Maximum No. of Participants</b>	<b>50</b>
<b>You Should Attend If you are</b>	<ul style="list-style-type: none"><li>▪ A mathematician interested in to use the modern non-linear tools such as fractals and Chaos in dimension theory and interpolation problems.</li><li>▪ An engineering 4th year student or a M.Sc. final year student interested to apply fractals in project or research.</li><li>▪ Working in industry with applications of fractals and fractal dimensions.</li></ul>
<b>Course Registration Fees</b>	<p>The participation fees for taking the course is as follows: <b>Student Participants:</b> Rs. 2000 <b>Faculty Participants:</b> Rs. 3000 <b>Government Research Organization Participants:</b> Rs. 5000 <b>Industry Participants:</b> Rs.5000 <b>Foreign Participants:</b> USD 100</p> <p>The above fee is towards participation in the course, the course material, computer use for tutorials and assignments, and laboratory equipment usage charges.</p> <p><b>The students should register themselves at the GIAN Portal in the URL:</b> <a href="https://gian.iitkgp.ac.in/GREGN/index">https://gian.iitkgp.ac.in/GREGN/index</a></p>

	<p>After registration, find the GIAN Course Code: <b>191003K02</b> to complete the course registration by <b>paying course fees online</b>.</p> <p>Online transfer: Click here to pay: <a href="https://elearn.nptel.ac.in/gian/">https://elearn.nptel.ac.in/gian/</a></p>
<b>Accommodation</b>	<p>The participants may be provided with hostel accommodation, depending on availability, on payment basis. Request for hostel accommodation may be submitted through the link:  <a href="http://hosteldine.iitm.ac.in/iitmhostel/">http://hosteldine.iitm.ac.in/iitmhostel/</a></p>



## Course Faculty

**Dr. Károly Simon** is a mathematics professor at the Budapest University of Technology and Economics (BME). Currently, he is the head of the Department of Stochastics at BME. He is internationally acclaimed for his contributions in dynamical systems, fractal geometry, and geometric measure theory. Besides influencing through his theoretical results, he also puts great emphasis and detail on passing on his knowledge whether it be a talk to experts in the field, a minicourse for postgraduates or a module for undergraduates. Károly Simon was awarded the Tibor Szele Memorial Prize by the János Bolyai Mathematical Society for his outstanding work in mentoring young mathematicians, noticing and developing talent early on. He has guided several Post-docs, Ph.D. . Master and Bachelor students on fractals and dynamical systems. He published around 100 research papers in the reputed international journals and conference proceedings. He delivered numerous invited talks on Fractals, Dynamical Systems, Geometric Measure Theory and Network Theory in International Conferences and Workshops.

<https://math.bme.hu/~simonk/>



**Dr. Arya Kumar Bedabrata Chand** is a Professor of Indian Institute of Technology, Madras. His research interests are Fractal Functions, Fractal Approximation, Numerical Analysis, Fixed Point Theory and Computer Aided Geometric Design. He works on theory and applications of smooth or non-smooth fractal interpolation functions. His notably contributions includes fractal splines, fractal rational approximation, shape preserving fractal splines/surfaces and cyclic iterated function systems. He published more than 100 research articles on fractal functions and their applications.

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