

Preface

The essential question that fractal dimensions attempt to answer is about the *scales* in Nature. This is not exactly a new question. From Euclid to Poincare to Mandelbrot, many philosophers, mathematicians, physicists had thought about transformation, dilation, and contraction of scales. Why is it important to investigate this problem? It is important not merely to document the characteristic scales observed in various phenomena of real world, there's something more fundamental than that. Our understanding of physics of a system might at times be dependent on our selection of scales (or resolutions) at which we investigate a system. Hence an idea about *scaling* and (possible) *scale-invariance* assumes significance when we attempt to study any physical system. For a system as non-idealistic and complex as a protein is, the question of studying *scale-invariance*, becomes particularly important. One may (realistically) hope that investigations related to *scaling* of biophysical and biochemical behaviors may one day help us to formulate a fundamental theory about protein biophysics; which, in turn, may help us to understand proteins from a set of fundamental principles.

In particular, this (small) book will attempt to investigate the diverse facets of the question: *among the various scales at which we describe protein biophysical and biochemical phenomena, which scales are scale-invariant?* A detailed exploration of this problem will perhaps help us to investigate an even deeper question: *how does evolution determine the fundamental scales of biological world?*

There are quite a few fantastic textbooks on mathematics of fractals and renormalization theory. These topics will not be dealt with in the present work. Furthermore, this book will not talk about the various methodologies and results associated with multifractal description of protein properties. Instead of being mathematically pedagogic, the approach adopted throughout the course of this book will be qualitative, with clear onus on discussions related to protein structures. Having said that, since it is absolutely obligatory for the readers to understand the concept of fractals, a (largely) qualitative and (somewhat) long discussion about fractal dimensions is kept in the introduction of the book. Furthermore, since it is imperative to have slight idea of polymer and polymer collapse for anybody studying Fractal Dimension (FD)-based treatments of proteins, a brief section to compare and contrast polymer collapse and protein folding has been provided.

This book attempts to collate and classify the various FD-based approaches that have been employed over the years to study protein interior biophysical properties into distinct clusters. It then presents an account of cases where FD-based methodologies have successfully contributed to protein interior research. In this context, a thorough documentation of accurate predictions made from the spectrum of FD-based studies is provided. However, fractals are no panacea, and they cannot suggest magic solutions to all the problems of protein biophysics. Consequently, a third aim of this book is to examine the intrinsic limitations of FD-based measures. Finally, with a balanced assessment of the entire framework, the book attempts to identify some of the outstanding questions for which the application of FD-based investigations may help in deciphering deep and unexpected facets of protein interior organization.

This book would not have come to being without the direct or indirect support from countably infinite number of well-wishers of mine. I thank them all. I would like to take this opportunity to thank all those who asked me questions about fractals and proteins over the years, and especially to those whom I could not answer for my lack of knowledge and/or conception. These questions stayed with me and forced me to spend more time in library and in my work. In a way, it is through these interactions that I learned whatever little I have learned about fractals and proteins. Thank you all.

This preface will be incomplete if I do not mention the roles of the editors, Dr. Beatrice Menz and (later on) Dr. Jutta Lindenborn during the course of writing the book. They were always supportive, always encouraging. I thank Dr. Menz especially for entrusting me with the responsibility of writing this book.

There is nothing more helpful than to listen to constructive criticisms; thus, if you feel like criticizing and/or discussing and/or (in the unlikely case) appreciating any aspect of whatever that is written in the book, please drop me an email ([anirbanab][what goes here][gmail.com]). I will be delighted to talk to you and learn from you.

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