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Poster n°2008-22

ANIFRAC : Uncertainties in processes with fractal characteristics

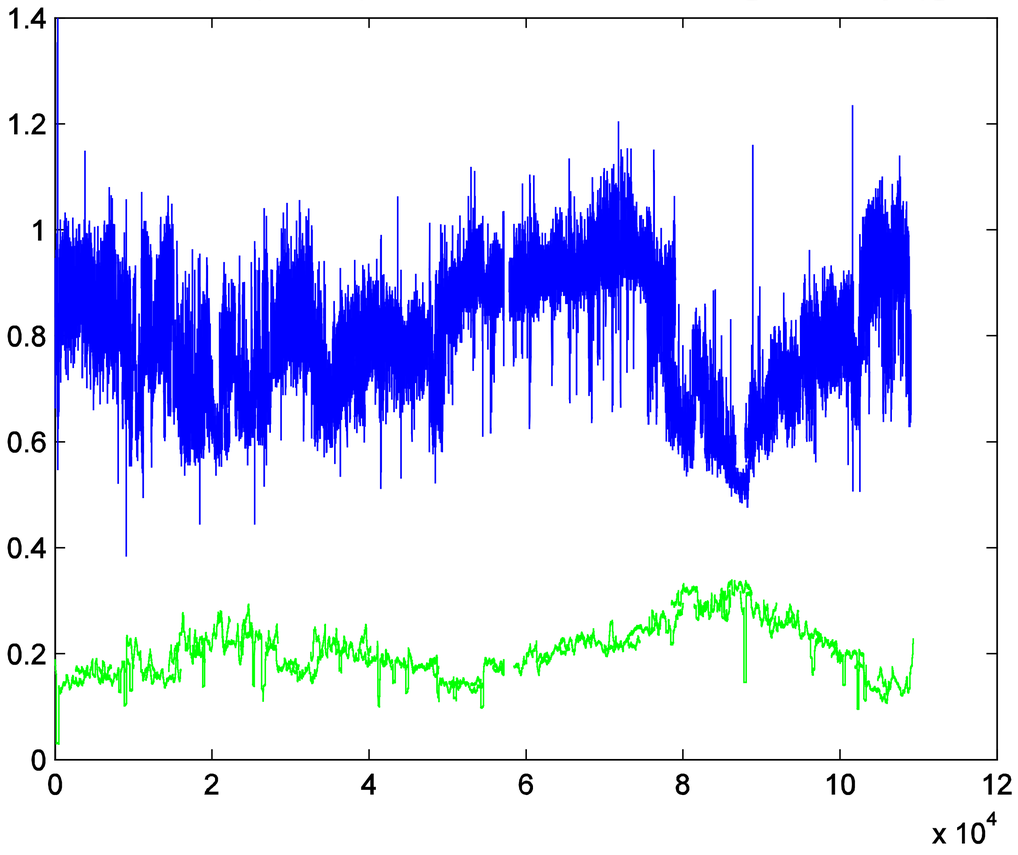
Abstract: In most real world systems, the environment is incompletely known, due, e.g., to finite precision of measurements, noises of diverse kinds, approximations needed to sum up the action of too many variables, etc... In order to obtain robust descriptions and controls of such systems, one needs to quantify these various sources of *uncertainties* and to incorporate them in the models. A powerful way to do so is to use stochastic modeling. However, it is not possible to obtain useful results while staying at a fully general level. The aim of the ANIFRAC project is to develop a methodology to deal with uncertainties in the case where fractal properties are involved in some ways.

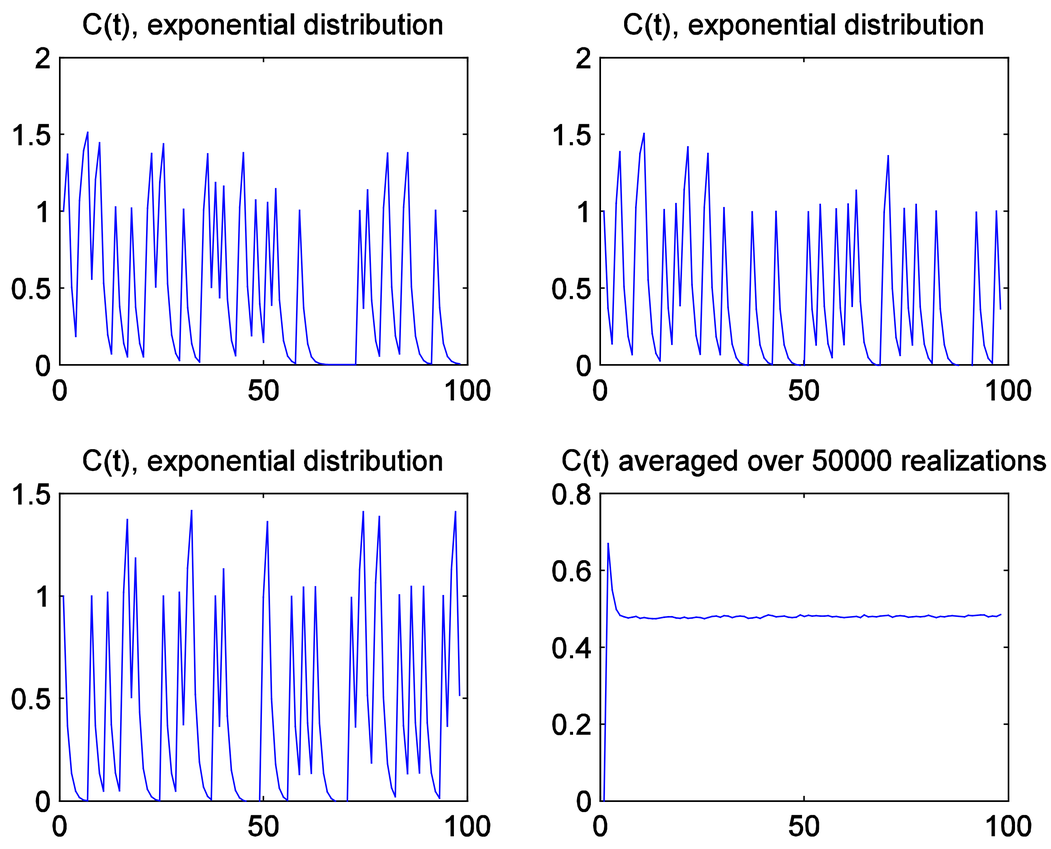
We will concentrate on two specific situations of interest:

In the first one, we will consider RR intervals obtained from ECG. Here, fractality is part of process: It is well known that RR time series display strong fractal characteristics. Moreover, these characteristics are linked with the condition of the heart. Healthier hearts typically have a larger fractal dimension, average lower local regularity and wider multifractal spectrum. However, these are only statistical properties. Our aim in ANIFRAC will be to try and incorporate uncertainties at various stages in order to obtain results for specific patients. In that view, new fractal models will be developed.

The second situation is in pharmacodynamics. We will investigate the problem of poor compliance in drug intake. Indeed poor adherence to treatment is a worldwide problem of striking magnitude that threatens efficacy of therapy. In this second case, fractality occurs only as a result of the "uncertainties" : fair compliance leads to smooth drug concentration curves, while, under certain circumstances of poor compliance, the probability distribution of concentration becomes fractal. Again, we will precisely analyze how the uncertainties due to poor compliance propagate to perturb the drug concentration.

RR intervals (blue) and estimated regularity (green)





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