



“V Escuela de Verano en Sistemas Complejos”

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Ryan Woodard, Ph.D. Physics. University of Alaska Fairbanks, researcher at the British Antarctic Survey Cambridge. Su investigación incluye estudios de eventos de conflicto y cooperación; los glaciares y las capas de hielo de la tierra como sistemas complejos; plasmas reducidas y criticalidad autoorganizada. URL <http://www.antarctica.ac.uk/> Course: “Using power spectra to probe the dynamics of a system”; Abstract: <http://www.timehaven.org/iscv/>

Using power spectra to probe the dynamics of a system

Abstract

You are a scientist. You collect data. Your data changes with time. You want to analyze your time series and ask a fundamental question: is it [random](#)? As a scientist your job is to answer this question. The more interesting result is that your data is not random. Now you must understand why that is so. The [power spectrum](#) is an excellent tool to use to begin this analysis. Often, power spectra contain regions that scale as a power law and the fun really begins. In combination with other measures, such as [probability distribution functions](#) and [rescaled range analysis](#), a system can be probed and dissected to tease out as much information as possible. I will give practical instruction in how to use the spectrum in conjunction with other measures to learn about the dynamics of a system. I will also present examples from recent literature in fields of plasma physics, biology, climatology and self-organized criticality, where the power spectrum has been used.

To take full advantage of our time, please read and understand the basic mathematics of a power spectrum. We will not use much math in these lectures, but at the least you should understand that a power spectrum is the square of the [Fourier transform](#) and that it is plotted as a function of frequency (or the inverse unit of the original data series). If you have any questions about your preparation for these lectures, please write me. I will try to make the lectures understandable for students with a wide range of mathematical experience. So do not worry.

If you have power spectra from your own work or if you see some in the literature that you would like to discuss, I would be happy to try to help. Please send me a reference in advance and I will take some time to review it.

Please check here on 5 January for possible updates to these notes. I will try to post most of my slides for the lectures on this page by 11 January.

Please write with any questions.



References

See links in above text.

[Link](#) to a good, simple example of a spectral peak at the frequency of a sine wave.

[Books and papers](#). I particularly recommend the books by Bracewell and Percival and the paper by Woodard.

[Ryan Woodard](#)

Fuente: <http://www.timehaven.org/iscv/>