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The Energy of Stochastic Vibration System of a Class of Protein Base on Wavelet

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Abstract

The study of protein stochastic system is very important in theorem and application. Recently, using wavelet, some persons have studied wavelet problems of stochastic processes or stochastic system, We take wavelet and use them in a series expansion of signals or functions, Wavelet has its energy concentrated in time to give a tool for the analysis of transient and nonstationary and time-varying phenomena. Wavelets have contributed to this already intensely developed and rapidly advancing field. In this paper, we study the energy of a stochastic vibration system of a class of protein through wavelet alternation. We give out the equation of the protein stochastic vibration system, and obtain Wavelet expansions of system for processes that are continuous in mean square. We obtain some new results for the study of the protein stochastic vibration system.

Key words: Wavelet alternation; Protein; Stochastic system; Energy

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INTRODUCTION

The study of protein system are very important[1-4]. In this paper, we study the energy of a stochastic vibration system of a class of protein through wavelet alternation.

With the rapid development of computerization, computerized scientific instruments come a wide variety of interesting problems for data analysis and signal processing. In fields ranging from Extragalactic Astronomy to Molecular Spectroscopy to Medical Imaging to computer vision, one must recover a signal, curve, image, spectrum, or density from incomplete, indirect, and noisy data. Wavelets have contributed to this already intensely developed and rapidly advancing field.

Wavelet has its energy concentrated in time to give a tool for the analysis of transient, nonstationary, or time-varying phenomena. It still has the oscillating wavelike characteristic but also has the ability to allow simultaneous time and frequency analysis with a flexible mathematical foundation. We take wavelet and use them in a series expansion of signals or functions much the same way a Fourier series the wave or sinusoid to represent a signal or function.

Wavelet analysis consists of a versatile collection of tools for the analysis and manipulation of signals such as sound and images as well as more general digital data sets, such as speech, electrocardiograms, images. Wavelet analysis is a remarkable tool for analyzing function of one or several variables that appear in mathematics or in signal and image processing. With hindsight the wavelet transform can be viewed as diverse as mathematics, physics and electrical engineering. The basic idea is always to use a family of building blocks to represent the object at hand in an efficient and insightful way, the building blocks themselves come in different sizes, and are suitable for describing features with a resolution commensurate with their size.

There are two important aspects to wavelets, which we shall call "mathematical" and "algorithmical". Numerical algorithms using wavelet bases are similar to other transform methods in that vectors and operators are expanded into a basis and the computations take place in the new system of coordinates. As with all transform methods such as approach hopes to achieve that the computation is faster in the new system of coordinates than in the original domain, wavelet based algorithms exhibit a number of new and important properties. Recently some persons have studied wavelet problems of stochastic process or stochastic system[5-13].

We know[4] the equation of the protein vibration system is:

$$\frac{dx(t)}{dt} = A - Bx(t) - cx(t-\tau) \tag{1}$$

We study its stochastic action as follow.

Let $p(n, t)$ is the probability of system at time t, its reflect equation:

$$\begin{aligned}\frac{dp(n,t)}{dt} = & A(p(n-1,t) - p(n,t)) + B((n+1)p(n+1,t)) \\ & - np(n,t) + c\sum_{m=0}^{\infty} m(p(n+1,t;m,t-\tau) \\ & - k_n p(n,t;m,t-\tau) \\ & n = 0, 1, 2, \ldots\ldots, \infty \end{aligned} \tag{2}$$

where, $p(n, t; m, t-\tau)$ express the joint probability of system have n molecular at time t and have m molecular at time $t-\tau$

$$k_n = \begin{cases} 0, n = 0 \\ 1, n > 0 \end{cases} \text{ when } n \text{ is negative,}$$

$p(n, t)=0$, $p(n,t;m,\ t-\tau)=0$

Supose, $p(n,t;m,t-\tau) = p(n,t)p(m,t-\tau)$

Then we have

$$\begin{aligned}\frac{dp(n,t)}{dt} = & A(p(n-1,t) - p(n,t)) \\ & + B((n+1,t)p(n+1,t) - np(n,t)) \\ & + c\sum_{m=0}^{\infty} mp(m,t-\tau)(p(n+1,t) - k_n p(n,t)) \\ = & A(p(n-1,t) - p(n,t)) \\ & + B((n+1,t)p(n+1,t) - np(n,t)) \\ & + C\langle n(t-\tau)\rangle (p(n+1,t)\, k_n p(n,t)) \\ & n = 0, 1, 2, \ldots\ldots, \infty \end{aligned} \tag{3}$$

We introduction function:

$$G(s,t)=\sum_{k=0}^{\infty} S^k p(k,t1n,0$$

Use the main equation[4]:

$$\frac{\partial p(y,t)}{\partial t} = \int \{w(y\,|\,y')p(y',t) - w(y'\,|\,y)p(y,t)dy$$

We can obtain:

$$\frac{2G(s,t)}{\partial t} = (s-1)\left[AG(s,t) - B\frac{2G(s,t)}{\partial s} - C\frac{\langle n(t-\tau)\rangle}{s}(p_o(t) - G(s,t)\right] \tag{4}$$

We can obtain solution of (4):

$$G(s)=S^{A_1}e^{A_2(s-1)} \tag{5}$$

Where A_1 and A_2 are Constant.

THE ENERGY OF THE PROTEIN SYSTEM BASE ON WAVELET

Let function

$$\psi(t) = \begin{cases} 1, -1 < t < 0 \\ -1, 0 < t < 1 \\ 0, \end{cases}$$

We call it as Haar wavelet[9].

The wavelet alternation of $G(t)$ is

$$Ws=\int_{-1}^{1}\psi(t)G(t)dt$$

Ws is the energy of system (4)

We have

$$Ws=\int_{-1}^{0} t^{A_1}e^{A_2(t-1)}dt - \int_{0}^{1} t^{A_1}e^{A_2(t-1)}dt$$

Use $\int x^n e^{ax}dx = \frac{1}{a}x^n e^{ax} - \frac{n}{a}\int x^{n-1}e^{ax}dx$

we have

$$Ws=\int_{-1}^{0} t^{A_1}e^{A_2 t}e^{-A_2}dt - \int_{0}^{1} t^{A_1}e^{A_2 t}e^{-A_2}dt$$

$$=F\int_{-1}^{0} t^{A_1}e^{A_2 t}dt - F\int_{0}^{1} t^{A_1}e^{A_2 t}dt$$

Where $F = e^{-A_2}$

$$I_1=\int_{-1}^{0} t^{A_1}e^{A_2 t}dt$$

$$=-\frac{1}{A_2}(-1)^{A_1}e^{-A_2} - \frac{A_1}{A_2}\int_{-1}^{0} t^{A_1-1}e^{A_2 t}dt$$

$$I_2=\int_{0}^{1} t^{A_1}e^{A_2 t}dt$$

$$=\frac{1}{A_2}e^{A_2} - \frac{A_1}{A_2}\int_{0}^{1} t^{A_1-1}e^{A_2 t}dt$$

If we let A_1=2, then

$$I_1=-\frac{1}{A_2}e^{-A_2} - \frac{2}{A_2}\int_{-1}^{0} te^{A_2 t}dt$$

$$=-\frac{1}{A_2}e^{-A_2} + \frac{2}{A_2{}^2}\left[e^{-A_2} + \frac{1}{A_2}(1-e^{-A_2})\right]$$

$$I_2=\frac{1}{A_2}e^{A_2} - \frac{A_1}{A_2}\int_{0}^{1} te^{A_2 t}dt$$

$$=\frac{1}{A_2}e^{A_2}-\frac{A_1}{A_2}\left[\frac{1}{A_2}e^{A_2}-(\frac{1}{A_2}e^{A_2}-\frac{1}{A_2})\right]$$

$$=\frac{1}{A_2}e^{A_2}-\frac{A_1}{A^3{}_2}$$

Then, we have

Ws = $F(I_1-I_2)$

$$=F\left[-\frac{1}{A_2}e^{-A_2}+\frac{2}{A_2{}^2}e^{-A_2}+\frac{2}{A_2{}^3}(1-e^{-A_2})+\frac{1}{A_2}e^{A_2}-\frac{A_1}{A_2{}^3}\right]$$

$$=-\frac{1}{A_2}e^{-A_2}+\frac{2}{A_2{}^2}e^{-A_2}+\frac{2}{A_2{}^3}e^{-A_2}-\frac{2}{A_2{}^3}e^{-2A_2}+\frac{1}{A_2}-\frac{A_1}{A_2{}^3}e^{-A_2}$$

WAVELET EXPANSIONS OF SYSTEM

For processes that are continuous in mean square,

i.e. $E\left|G(t)\right|^2<\infty$ and $E\left|G(t)-G(s)\right|^2\to 0$ as→s.[5]

we consider wavelet expansions of stochastics processes and show that for certain wavelets, the coefficients of the expansion have negligible correlation for different scales. We can introduce a modification of the wavelets. Certain nonstationary processes the wavelets may be chosen to give uncorrelated coefficients.

We observe that the approximation of G(t) by $G_m(t)$, where

$$G_m(t)=\sum_n a_{mn}\phi_{mn}(t),\quad a_{mn}=\int G(t)\phi_{mn}(t)dt$$

is mean square for any $\phi\in Sr,$ that is: $E[G(t)\text{-}G_m(t)]\to 0$, as $m\to\infty$, $t\in R$, we express $G_m(t)$ in the wavelet series is, $G_m(t)=\sum_{k=-\infty}^{m-1}\sum_{n=-\infty}^{\infty}b_{kn}\ \varphi_{kn}(t)$,

Where $b_{kn}=\int_{-\infty}^{+\infty}G(t)\varphi_{kn}(t)dt$

Then we have

$$\lim_{m\to\infty}G_m(t)=G(t)$$

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