Soliton solution of sine-Gordon model of DNA

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Abstract

There are many models of DNA, both the linear ones and the nonlinear ones. One interesting model in this regard is the sine-Gordon model of DNA as proposed by Daniel and Vasumathi. It belongs to nonlinear model of DNA which is close to realistic model. Here we discuss a graphical plot of soliton solution of such a sine-Gordon model of DNA.

Introduction

There are many models of DNA, both the linear ones and the nonlinear ones [1]. One interesting model in this regard is the sine-Gordon model of DNA as proposed by Daniel and Vasumathi [2]. It belongs to nonlinear model of DNA which is close to realistic model. Here we discuss a graphical plot of soliton solution of such a sine-Gordon model of DNA.

Soliton solution in a sine-Gordon model of DNA

Assuming the wavefunction Ψ to be a function of x and t, then the sine-Gordon model of DNA can be written as follows: [2, p.7]

(1)

Or in Mathematica expression:

```
♥=U[x-c t];
pde=D[♥,x,x]-D[♥,t,t]-sin[♥]عـ0
```

Now we will use Mathematica 9.0 to simplify and give graphical plot. [3, p.443]

To simplify with Mathematica:

The result is known as kink soliton wave: [3, p.444]

Or in Mathematica:

Differentiating for t, it yields:

Simplifying the above result, it yields:

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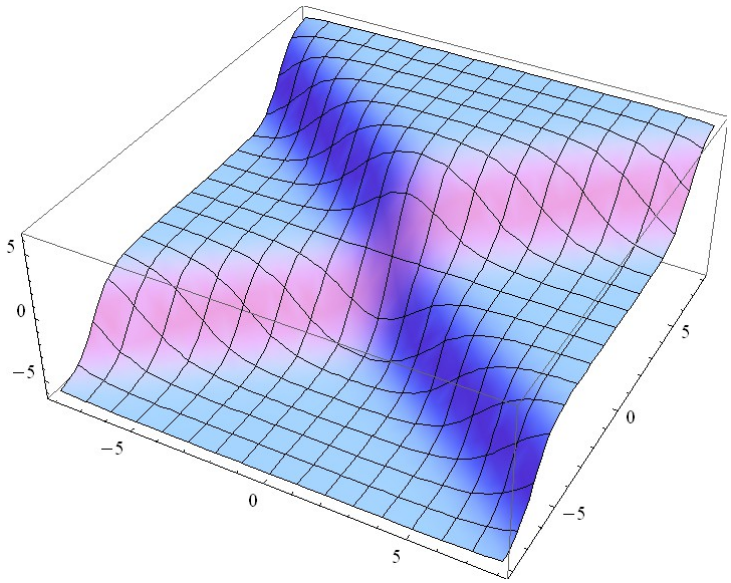
The 3D plot is given below for c= 0.72



Graphic 1. Mathematica plot of soliton solution on sine-Gordon equation for c=0.72

Concluding remarks

There are many models of DNA, both the linear ones and the nonlinear ones [1]. One interesting model in this regard is the sine-Gordon model of DNA as proposed by Daniel and Vasumathi [2]. It belongs to nonlinear model of DNA which is close to realistic model. Here we discuss a graphical plot of soliton solution of such a sine-Gordon model of DNA.

Considering that sine-Gordon equation has been used extensively by particle physicists, then it would be interesting to study possibility to improve or alter DNA using electromagnetic field/pulse such as laser. This may be considered as a DNA enhancement method.

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