Letter to the Editor

Numerical Solution of an Equation Corresponding to Schumann Waves

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Abstract

We consider an one-dimensional Schumann wave equation proposed by Marciak-Kozlowska. Numerical solution of that equation was obtained with the help of Mathematica.

Keywords: Schumann wave, numerical solution, equation.

Introduction

The measured frequencies of Schuman and brainwaves are nearly the same [1]. It is worthwhile to point out that both calculated curves give a rather good description of the measured frequencies of Schuman and brain waves [2-3].

We consider an one-dimensional Schumann wave equation proposed by Marciak-Kozlowska. Numerical solution of that equation was obtained with the help of Mathematica.

A hyperbolic equation for Schuman wave phenomena was formulated [4-5] where m is the mass of the neuron, $\hbar$ is the Planck constant, V is potential and v is the velocity propagation of the Schumann wave in the brain.

Now we will obtain its numerical solution without having to recourse to Klein-Gordon equation as its approximation [4]. Instead, we will look for direct numerical solution and its plot using Mathematica 9 [6]:

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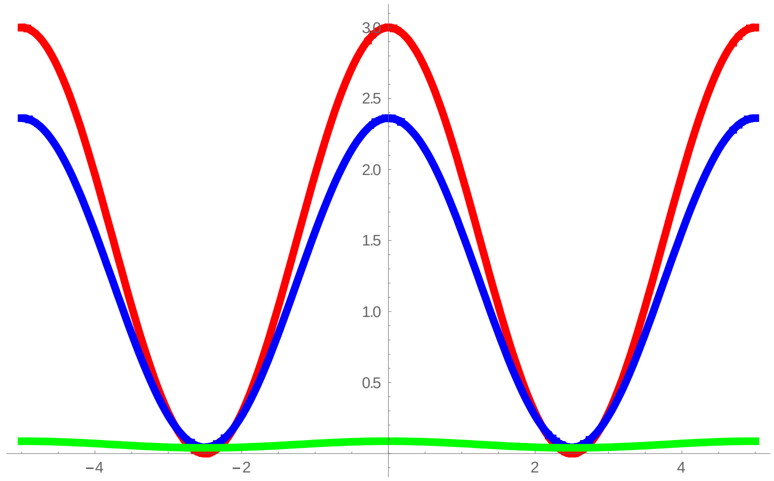

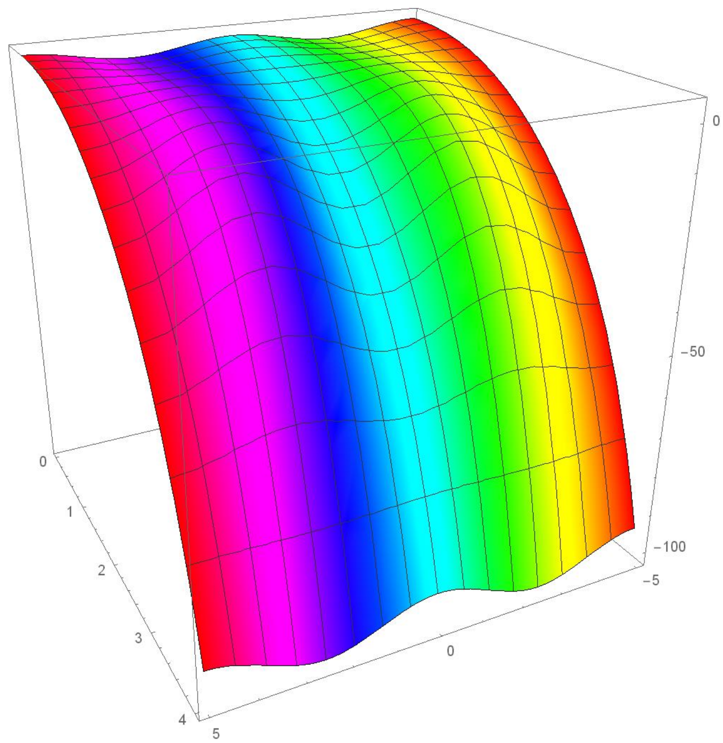

Concluding remarks

A direct numerical solution of master equation corresponding to Schumann wave has been presented. We hope this result may be useful for further studies on the connection between Schuman resonance, brainwaves and other related topics.

References

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[4] Marciak-Kozłowska, J. & Kozlowski, M., Klein-Gordon Equation for Consciousness Schumann Field. *Journal of Consciousness Exploration & Research* | July 2017 | Volume 8 | Issue 6 | pp. 441-446

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[6] Inna Shingareva & Carlos Lizárraga-Celaya. *Solving Nonlinear Partial Differential Equations with Maple and Mathematica*. 2011 Springer-Verlag / Wien, New York

Appendix: Mathematica code

```
SetOptions[Plot,ImageSize->500,PlotRange->All,PlotPoints->nP*2,PlotStyle-
>{Blue,Thickness[0.01]}];{s=1/100,nP=100}
{nN=3,l=1,l1={Red,Blue,Green},l2={0,1/2,1}}
f[u_]:=2*b*a/c^2;f[u]
eKG=D[u[x,t],{t,2}]+a*D[u[x,t]/c,{t,1}]-D[u[x,t],{x,2}]+f[u]==0
fIC1[f1_]:=u[x,0]==f1;fIC2[f2_]:=(D[u[x,t],t]/.t->0)==f2;
fBC1[c_,f1_]:=(D[u[x,t],x]/.x->c)==f1;
fBC2[d_,f2_]:=(D[u[x,t],x]/.x->d)==f2;
{fIC1[f1],fIC2[f2],fBC1[c,f1],fBC2[d,f2]};
params5={a->1,b->1,c->-1,aN->1.5};{c5=-
5,d5=5,tF5=4,xI5=c5,xF5=d5,f15=aN*(1+Cos[2*Pi*x/d5]),f25=0,f35=0,f45=0,eKG5=N[eKG/.params5],ic5=N[{fI
C1[f15],fIC2[f25]}/.params5],bc5=N[{fBC1[c5,f35],fBC2[d5,f45]}/.params5]}
sol5=NDSolve[Flatten[{eKG5,ic5,bc5}],u,{x,xI5,xF5},{t,0,tF5},MaxStepSize->s,PrecisionGoal->2]
Do[g[i]=Plot[Evaluate[u[x,l2[[i]]]/.sol5],{x,xI5,xF5},PlotStyle-
>{l1[[i]],Thickness[0.01]}],{i,1,nN}];Show[Table[g[i],{i,1,nN}]]
Plot3D[Evaluate[u[x,t]/.sol5],{x,xI5,xF5},{t,0,tF5},ColorFunction->Function[{x,y},Hue[x]],BoxRatios-
>1,ViewPoint->{1,2,1},PlotRange->All,PlotPoints->{20,20},ImageSize->500]
Animate[Plot[Evaluate[u[x,t]/.sol5,{x,xI5,xF5}],PlotRange->{-3,3}],{t,0,tF5},AnimationRate->0.5]
```