Numerical solution of master equation corresponding to Schumann waves

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Abstract

Following a hypothesis by Marciak-Kozlowska, 2011, we consider one-dimensional Schumann wave transfer phenomena. Numerical solution of that equation was obtained by the help of Mathematica.

Introduction

The measured frequencies of Schuman and brainwaves are nearly the same. [Persinger]. It is worth to underline that both calculated curves give a rather good description of the measured frequencies of Schuman and brain waves , see Marciak-Kozlowska [2][3]

Following a hypothesis by Marciak-Kozlowska, 2011, we consider one-dimensional Schumann wave transfer phenomena. Numerical solution of that equation was obtained by the help of Mathematica.

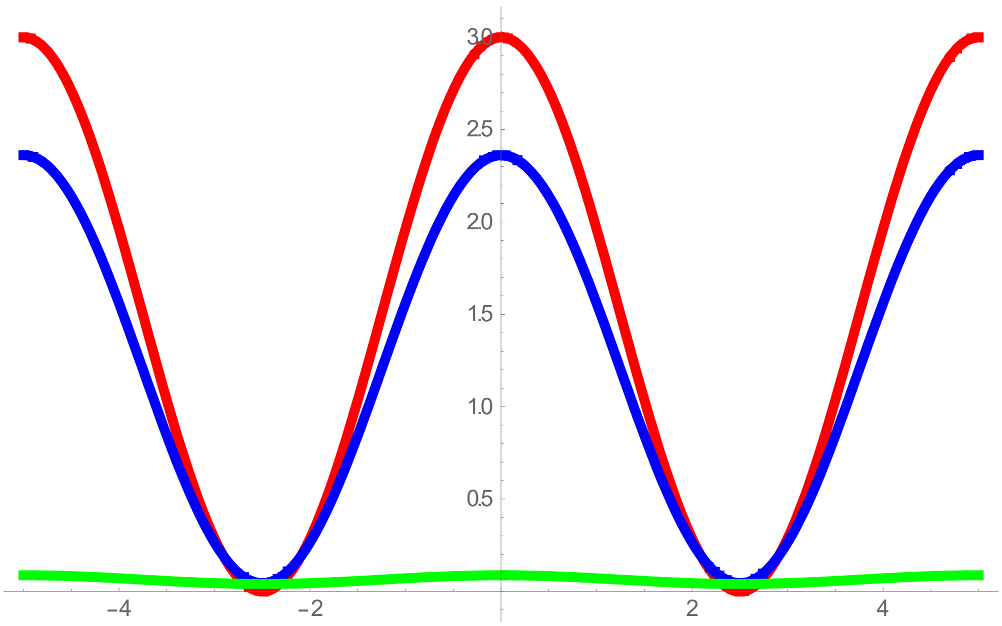
A hyperbolic master equation for Schuman wave phenomena was formulated [4][5], where in this equation m is the mass of the neuron, $\hbar$ - is the Planck constant, V is potential and v is the velocity propagation of the Schumann wave in the brain.

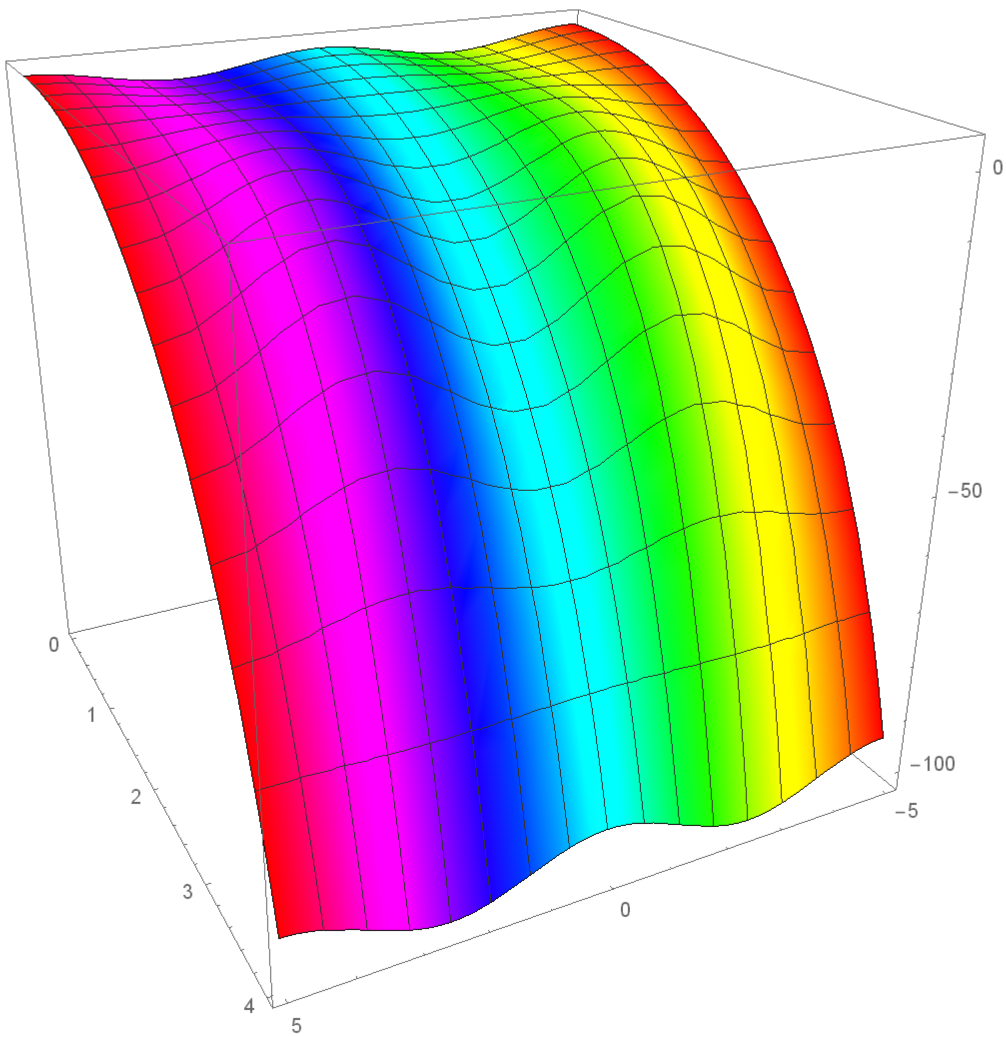
Now we will obtain its numerical solution without having to recourse to Klein-Gordon equation as its approximation. Instead, we will look for direct numerical solution and its plot using Mathematica 9.[6]

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[eK
G/.params5],ic5=N[{fIC1[f15],fIC2[f25]}/.params5],bc5=N[{fBC1[c5,f35],fBC2[d5,f45]}/.p
arams5]}
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]
```

Graphical plot:


3.0
2.5
2.0
1.5
1.0
0.5
−4
−2
2
4


0
−50
−100
−5
0
5
0
1
2
3
4

References:

[1] Persinger M, Schumann resonances frequencies found within quantitative electroencephalographic activity implications for Earth- Brain Interactions. *Int. Letters of Chemistry, Physics, Astronomy,* vol 30,2014
[2] Kozlowski M Marciak-Kozlowska J, Heisenberg Uncertainty Principle and Human Brain. *Neuroquantology* .vol 11 ,2013
[3] Kozlowski M, Marciak-Kozlowska J, Schumann Resonance and Brain Waves: A quantum description. *Neuroquantology,* vol13, 2015
[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
[5] Marciak-Kozłowska, J. & Kozlowski, M., On the Interaction of the Schumann Waves with Human Brain. *Journal of Consciousness Exploration & Research* | February 2017 | Volume 8 | Issue 2 | pp. 160-167
[6] Inna Shingareva & Carlos Lizárraga-Celaya. *Solving Nonlinear Partial Differential Equations with Maple and Mathematica*. 2011 Springer-Verlag / Wien, New York