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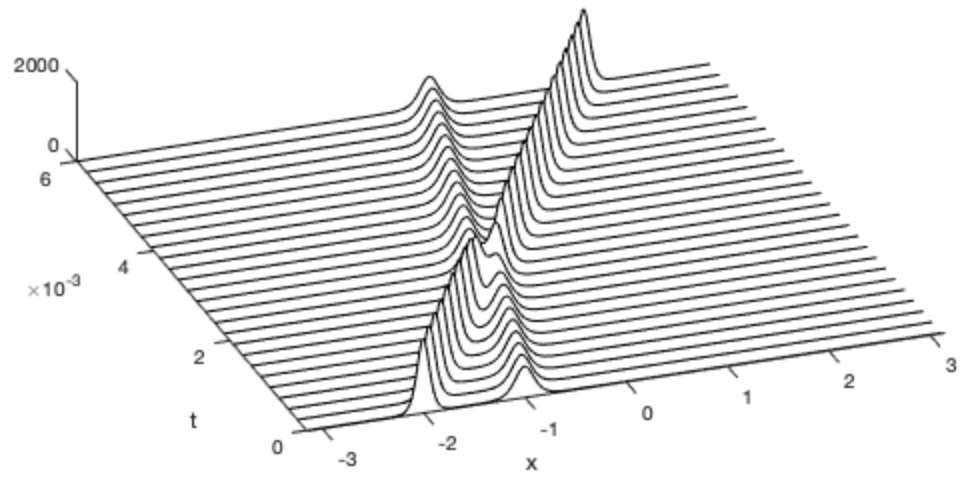
% p27.m - Solve KdV eq.  $u_t + uu_x + u_{xxx} = 0$  on  $[-\pi, \pi]$  by
%           FFT with integrating factor  $v = \exp(-ik^3t)*\hat{u}$ .

% Set up grid and two-soliton initial data:
N = 256; dt = .01/N^2; x = (2*pi/N)*(-N/2:N/2-1)';
A = 25; B = 16; clf, drawnow, set(gcf, 'renderer', 'zbuffer')
u = 3*A^2*sech(.5*(A*(x+2))).^2 + 3*B^2*sech(.5*(B*(x+1))).^2;
v = fft(u); k = [0:N/2-1 0 -N/2+1:-1]'; ik3 = 1i*k.^3;

% Solve PDE and plot results:
tmax = 0.006; nplt = floor((tmax/25)/dt); nmax = round(tmax/dt);
udata = u; tdata = 0; h = waitbar(0, 'please wait...');
for n = 1:nmax
    t = n*dt; g = -.5i*dt*k;
    a = g.*fft(real( ifft(      v      ) ).^2)+ik3.*v.*dt;
    b = g.*fft(real( ifft((v+a/2)) ).^2)+ik3.*(v+a/2).*dt;      % 4th-
order
    c = g.*fft(real( ifft(v + b/2) ).^2)+ik3.*(v+b/2).*dt;      %
Runge-Kutta
    d = g.*fft(real( ifft(v+c) ).^2)+ik3.*(v+c).*dt;
    v = v + (a + 2.*(b+c) + d)/6;
    if mod(n,nplt) == 0
        u = real(ifft(v)); waitbar(n/nmax)
        udata = [udata u]; tdata = [tdata t];
    end
end
waterfall(x,tdata,udata'), colormap(1e-6*[1 1 1]); view(-20,25)
xlabel x, ylabel t, axis([-pi pi 0 tmax 0 2000]), grid off
set(gca, 'ztick', [0 2000]), close(h), pbaspect([1 1 .13])

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*Published with MATLAB® R2018a*