(2 slide) Parabolic boundary-value problem

Let us consider the following parabolic boundary-value problem.

(1)

At points 0 and 1 there are set zero and linear edge conditions.

(conditions)

Function F is smooth and it has at least second infinitesimal order. This problem was stated by professors of YarSU Glyzin and Kaschenko

(3 slide) Substitutions

By means of these substitutions system (1) can be transformed to simplified boundary-value problem.

(4 slide) Simplified parabolic boundary-value problem

(5 slide) Deviate in edge condition

In the case of x0 = 0 system (2) has the following solution, where c is a constant and mu is a square root of lambda.

(6 slide) System of equations

For complex lambda real and imaginary part can be found from system (3).

(3)

Functions f and g are even for parameters tau and omega

(7 slide) Loss of stability for null solution

For simplified boundary-value problem there was noticed tha

(remark)

So the first task of my research was to consider the loss of stability for null solution of equation (1).

(8 slide) Numerical research

The numerical research was carried out by means of special software written in C++.

All calculations are performed on a large number of independent streams of GPU. So the program uses the technology of parallel calculations CUDA. Also there were wrote scripts in Python for parsing data and visualization of numerical results.

(9 slide) Search of roots

To search the roots of system (3) there was used the grid of fixed values of parameter tau and a method of dichotomy for parameter omega.

(10 slide) Critical value of alpha

Also the same methods of computations were implemented to search critical values of parameter alpha, when real part of lambda is equal to gamma.

(image)

On this image red cross point is a critical value of alpha, blue line is a value of parameter gamma and black points are roots of system (3) for fixed values of parameter alpha from its grid.

(11 slide)

(image)

On this slide there is showed a plot of gamma and critical alpha. For less values of alpha the plot has mirror and periodic behaviour.

(12 slide)

The second task of my research was to consider the system of differential equations, which model of boundary-value problem (1) and confirm given numerical results.

(differential equation)

In this case for equation (1) function F is gamma u minus u in cube.

(13 slide)

So let us consider a chain of connected oscillators.

(4)

Also for it there are determined the following initial conditions:

(conditions)

(14 slide)

(15 slide)