

Rectangular Membrane User Guide

K.N. Toosi University Of Technology

Electrical And Computer Engineering Faculty

Dr. Hadi Aliakbarian

Autumn 2017

Contents

1 Requirements	1
2 Brief Description Of Rectangular Membrane	1
3 How To Use The Application	1
4 About Us	5

1 Requirements

For running this application on your desktop computer, you must install JRE (Java Runtime Environment) on your computer. For more information on installing Java, refer to our guide on installing java.

2 Brief Description Of Rectangular Membrane¹

The model of the vibrating membrane for obtaining the displacement $u(x, y, t)$ of a point (x, y) of the membrane from rest $u = 0$ at time t is

$$(1) \quad \frac{\partial^2 u}{\partial t^2} = c^2 \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$$

$$(2) \quad u = 0 \text{ on the boundary}$$

$$(3a) \quad u(x, y, 0) = f(x, y)$$

$$(3b) \quad u_t(x, y, 0) = g(x, y).$$

Here (1) is the two-dimensional wave equation with $c^2 = T/\rho$ just derived, (2) is the boundary condition (membrane fixed along the boundary in the xy -plane for all times $t \geq 0$), and (3) are the initial conditions at $t = 0$, consisting of the given initial displacement (initial shape) $f(x, y)$ and the given initial velocity $g(x, y)$, where $u_t = \partial u / \partial t$

3 How To Use The Application

For using this application you must download it from the followed link: <https://wp.kntu.ac.ir/aliakbarian/pde/visualizations/rectangular-membrane/RectangularMemberaneFX.jar>

When you run the application something like figure 1 will be shown to you on the screen.

¹Advanced Engineering Mathematics 10th Edition, Erwin Kreyszig

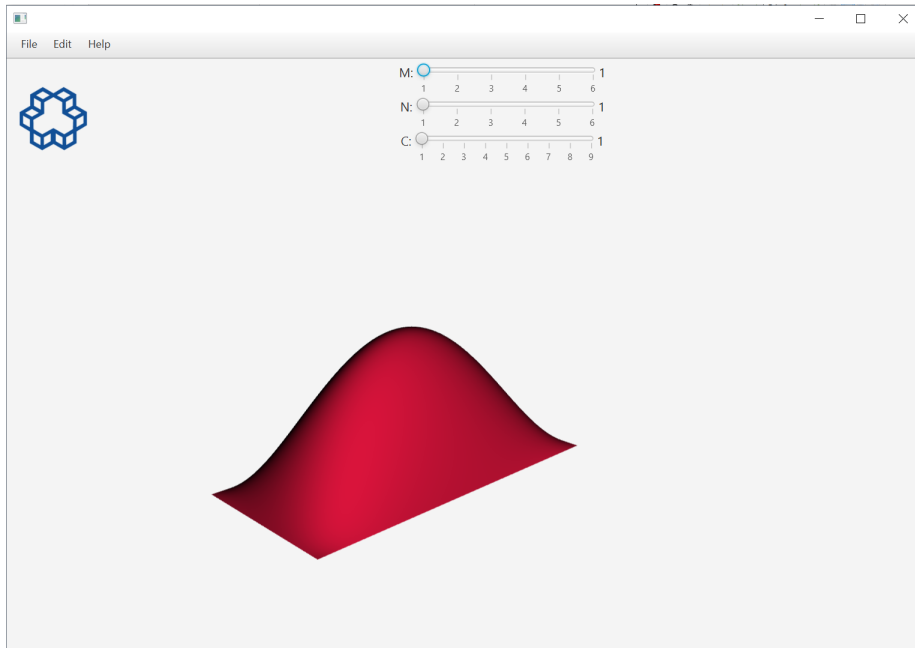


Figure 1: First Perspective

There are some buttons on top of the application, in File menu, you can save the result of your test as, a picture, by next button you can start animation or stop it, you can set a time and take the 3d plot of that time, you be able to change appearance of the plot, and finally you can migrate between single mode and multi mode which I will explain later, and by the last one you can see some information about the application.

Now we start in single mode, at the top of the application you see three sliders like 2



Figure 2: Sliders

By m,n sliders you can increase and decrease nodal lines in two orientation in membrane plot like 3

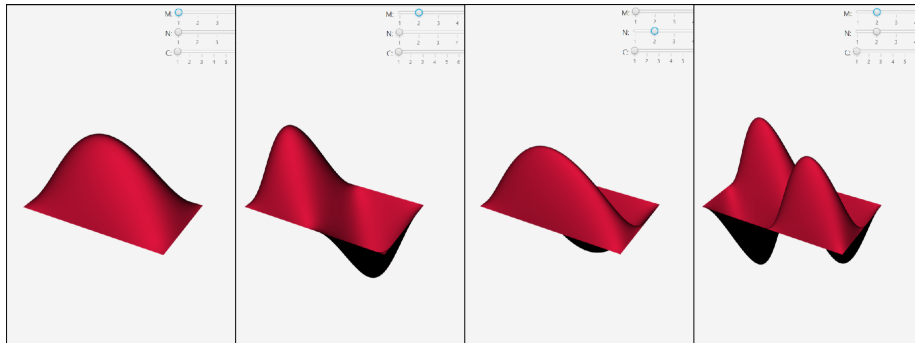


Figure 3: You Can Change Nodal Lines Of Plot

Last slider can change the coefficient of the wave equation (c) like 4; And you will see as more as you increase the c , the plot will animate faster.

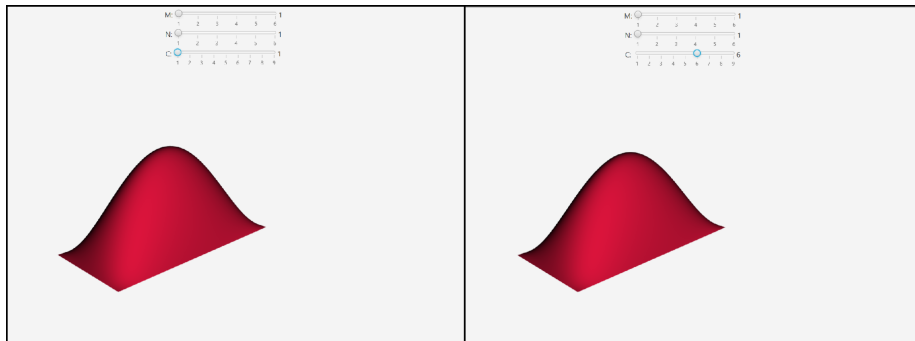


Figure 4: You Can Change The Coefficient Of The Equation

At the end I want to illustrate multi mode section, if you choose this mode something like 5 will be shown to you.

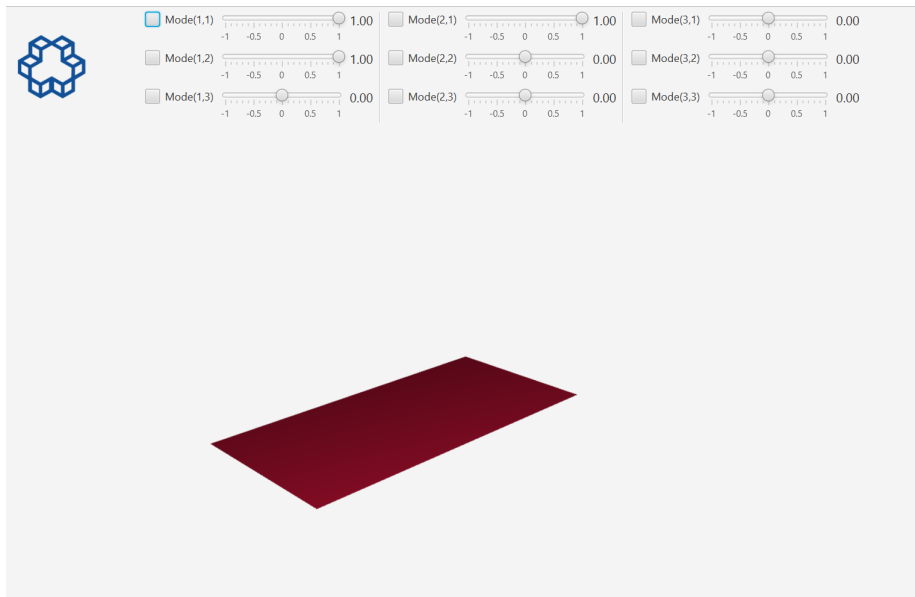


Figure 5: Multi Mode Perspective

Numbers next to the each mode define its nodal lines, and by its slider you can modify the impact ratio of this mode in the membrane plot like 6.

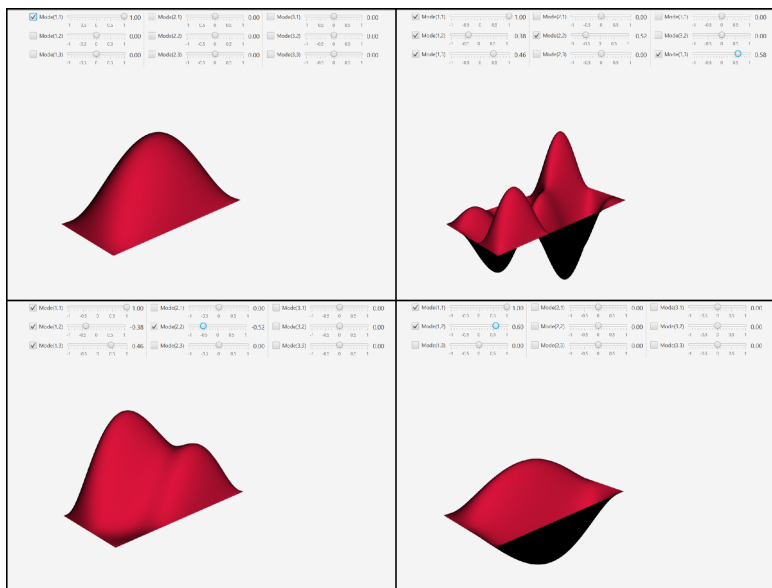


Figure 6: The Application Can Animate Membrane In Multi Mode

4 About Us

User guide is written by [Mahdi Kafi](#) on 11/17/2017

Application is developed by [Mohammad Hossein Rimaz](#) on 6/17/2016

Under supervision of [Dr. Hadi Aliakbarian](#)

K.N.Toosi University of Technology

Electrical and Computer Engineering Faculty

Copyrights all rights reserved.