

Sinpixa*

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Abstract: Seeking the sultion of a smooth equation.

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1. Introduction

Sinpixa is the project code name for Equation

$$\sin^2 \pi x + \sin^2 \frac{\pi a}{x} = 0, \tag{1.1}$$

where a is positive integer greater than 1.

Eq.1.1 expresses itself very difficult to be solved. Here, rather than seeking a solution, we would like to start an investigation upon the graphical presentation of this equation. For 1-manifold

$$y = \sin^2 \pi x + \sin^2 \frac{\pi a}{x}, \tag{1.2}$$

$y = \sin^2 \pi x + \sin^2 \frac{\pi a^+}{x}$ and $y = \sin^2 \pi x + \sin^2 \frac{\pi a^-}{x}$ are the homotopies of Function1.2, so do $a - 1$ and $a + 1$. Will the solutions of $a - 1$ or $a + 1$ give a kind of bound of the solutions of Eq.1.1, or mutually, or not at all?

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2. The beginning

First, we compute and visualize function

$$y = \sin^2 \pi x + \sin^2 \frac{\pi 6}{x}. \quad (2.1)$$

We computed two hundred and one points equally paced along x -axis. These points form the following diagram Fig(1). We can use qt-plaut to read the attached data file 's.sinpixa6'. The following are the qt-plaut instructions.

'add a solution' open 's.sinpixa6'.

click 'Scene tools', in drop box 'Uploaded solutions' choose '2d' at 'Plotting dimensions'

click 'Construct a manifold'.

Scroll down, in 'Manifold settings' choose 'hide'.

Scroll down, in 'Show orbits' choose 'all'.

In 'Put marks' click 'Read', locate and select file 'sinpixa6.lbl'.

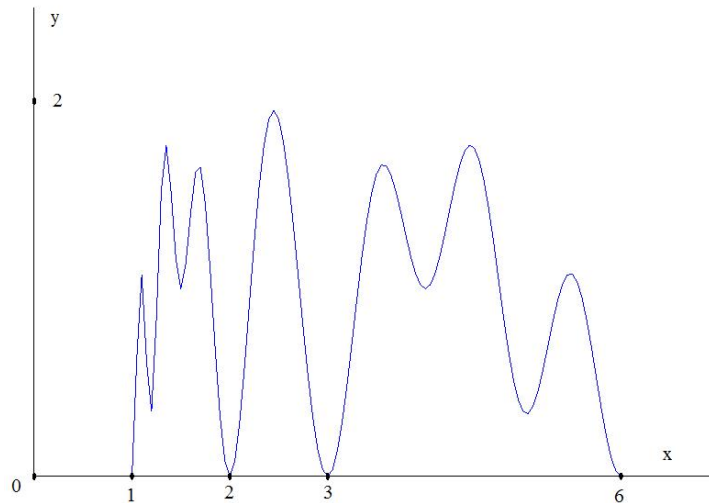


FIG 1. $y = \sin^2 \pi x + \sin^2 \frac{\pi a}{x}, a = 6.$

The diagram meets our expectation in general. We can also observe a “symetric”-like behavior about $x = \sqrt{6}$.

3. More diagrams

We compute and visualize more diagrams, e.g., $a = 7$, $a = 8$, $a = 9$, and $a = 143$. 143 is the product of 11 and 13. Comparing Fig (5) and Fig (6), Fig (5) demonstrates an interesting behavior we can not explain. Or it is just a coincidence.

In Fig (7), we adjust the function as $y = \sin^2 \pi x + 10 \sin^2 \frac{\pi a}{x}$, $a = 143$, it shows better how wave $\sin^2 \pi x$ and $\sin^2 \frac{\pi a}{x}$ interacts. One tries to touch down the x-axis, the other just prevent it from happening unless an exact coupling.

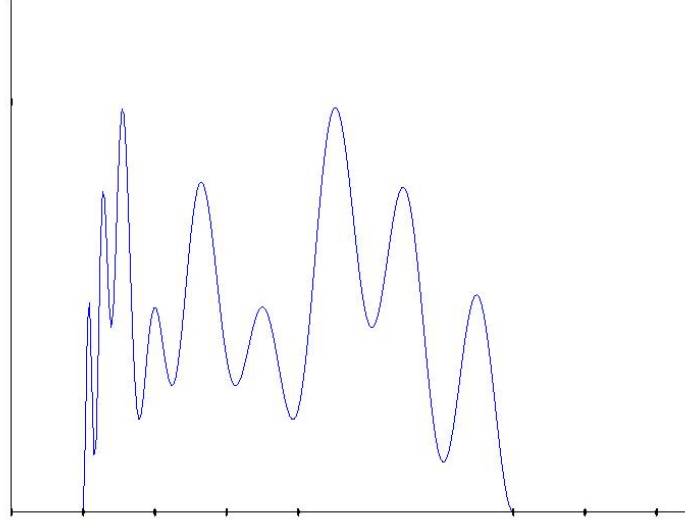


FIG 2. $y = \sin^2 \pi x + \sin^2 \frac{\pi a}{x}$, $a = 7$.

4. Manifold $z = \sin^2 \pi x + f_1 \sin^2 \frac{\pi y}{x}$

$$z = \sin^2 \pi x + f_1 \sin^2 \frac{\pi y}{x}, \quad (4.1)$$

is a 2-manifold (proof needed), where f_1 is a real constant. We draw part of this manifold as the following digrams.

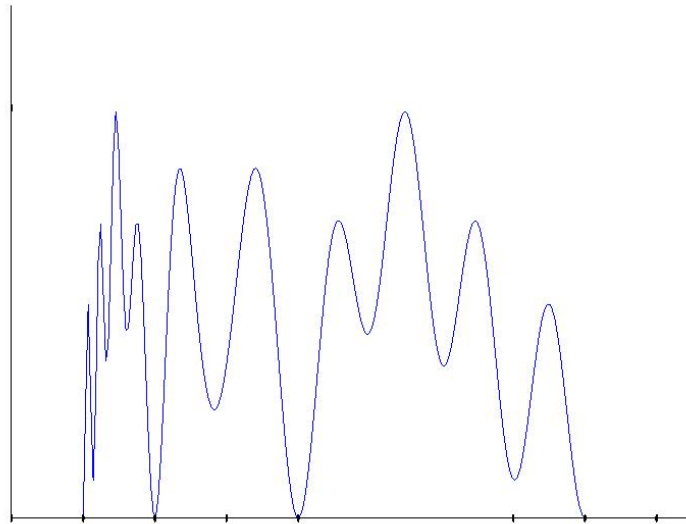


FIG 3. $y = \sin^2 \pi x + \sin^2 \frac{\pi a}{x}, a = 8.$

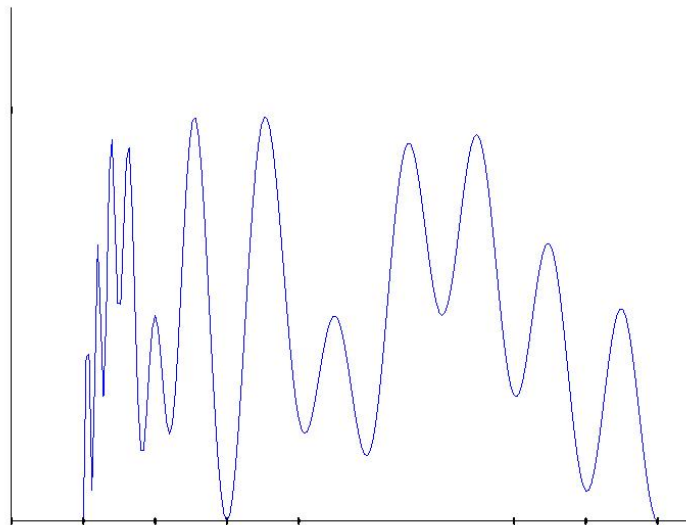


FIG 4. $y = \sin^2 \pi x + \sin^2 \frac{\pi a}{x}, a = 9.$

References

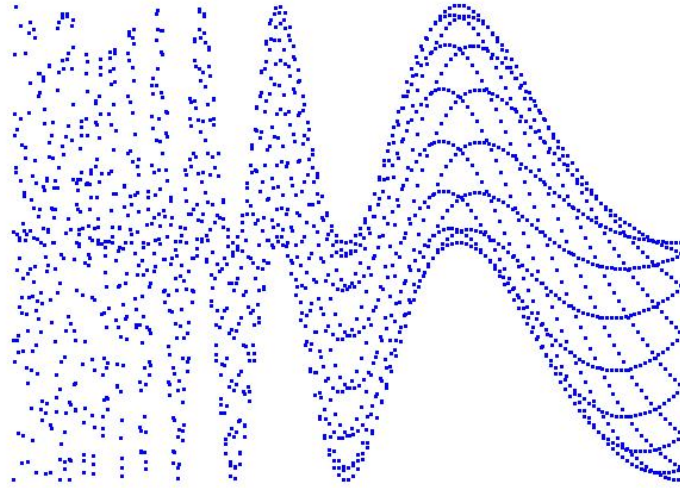


FIG 5. $y = \sin^2 \pi x + \sin^2 \frac{\pi a}{x}$, $a = 143$. The functions plotted as dots.

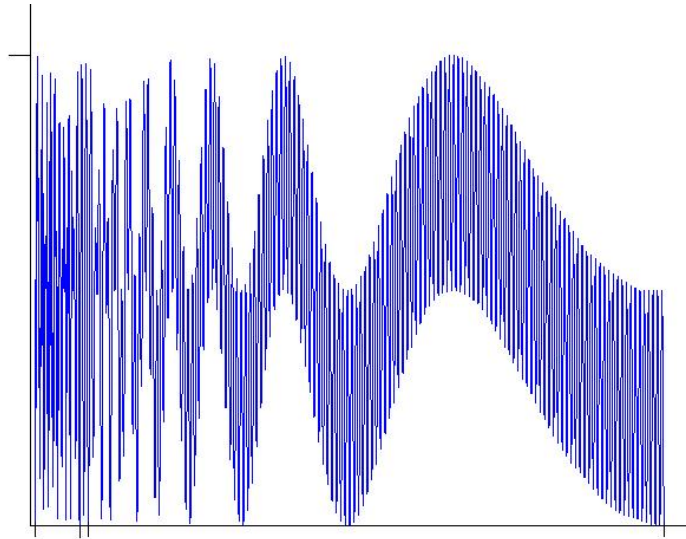


FIG 6. $y = \sin^2 \pi x + \sin^2 \frac{\pi a}{x}$, $a = 143$. The function is plotted as a curve. In the x -axis, we show points 1, 11, and 13.

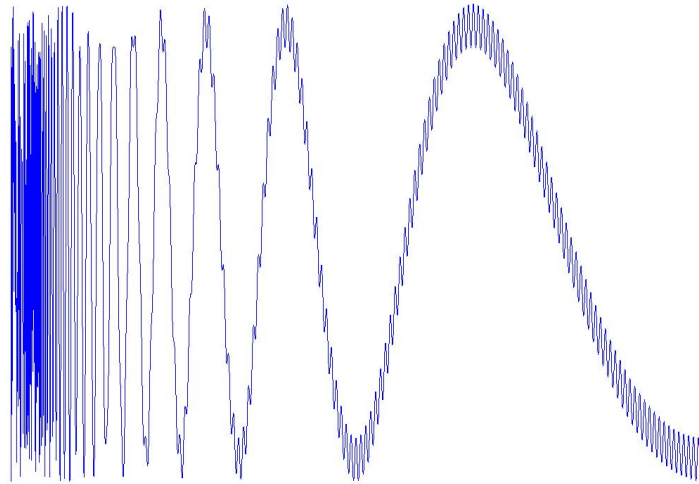


FIG 7. $y = \sin^2 \pi x + 10 \sin^2 \frac{\pi a}{x}, a = 143$.

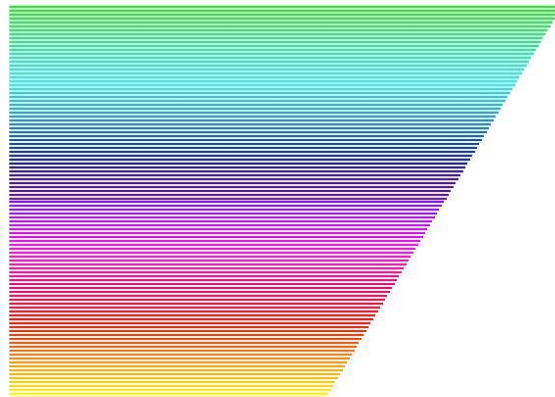


FIG 8. *Manifold* $z = \sin^2 \pi x + f_1 \sin^2 \frac{\pi y}{x}$, for $f_1 = 1, x \in [1, y]$ and $y \in [6, 8]$.

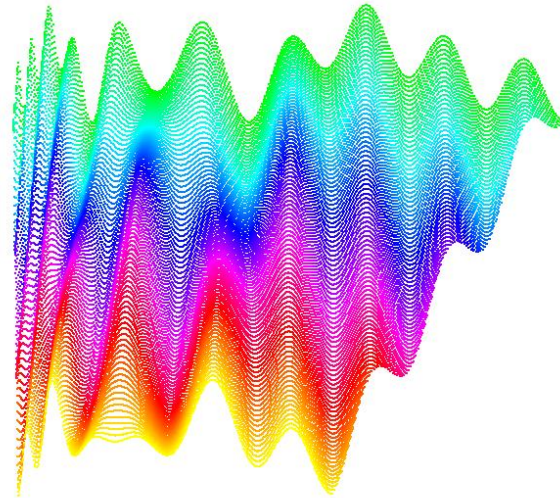


FIG 9. Manifold $z = \sin^2 \pi x + f_1 \sin^2 \frac{\pi y}{x}$, for $f_1 = 1$, $x \in [1, y]$ and $y \in [6, 8]$.

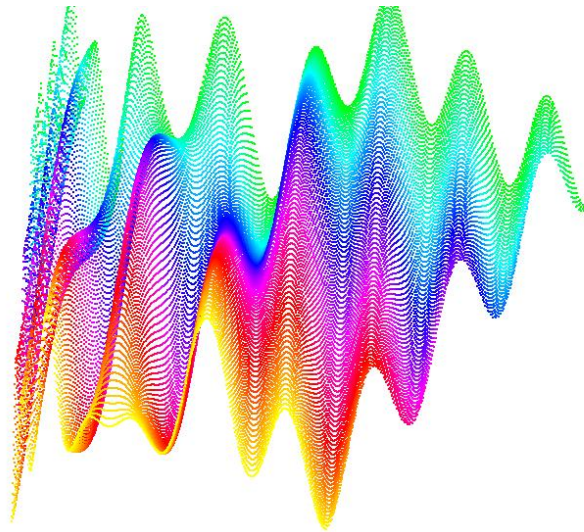


FIG 10. Manifold $z = \sin^2 \pi x + f_1 \sin^2 \frac{\pi y}{x}$, for $f_1 = 1$, $x \in [1, y]$ and $y \in [6, 8]$.

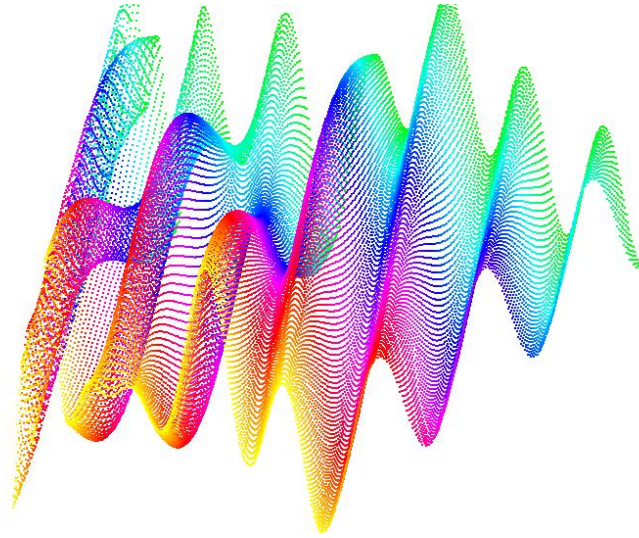


FIG 11. Manifold $z = \sin^2 \pi x + f_1 \sin^2 \frac{\pi y}{x}$, for $f_1 = 1$, $x \in [1, y]$ and $y \in [6, 8]$.

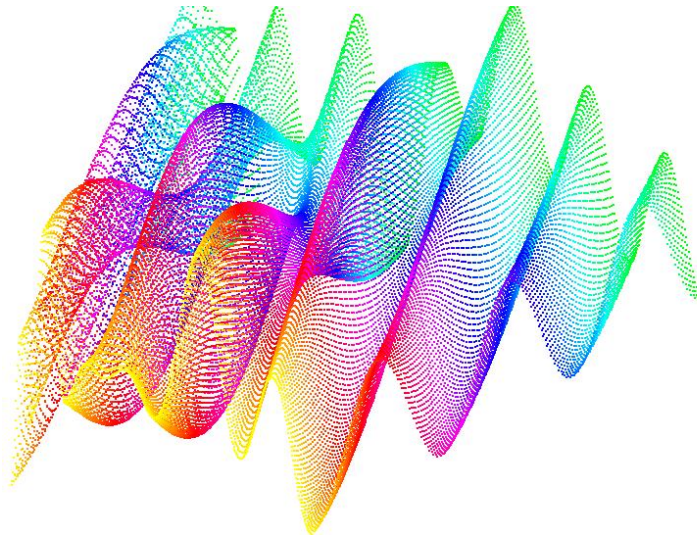


FIG 12. Manifold $z = \sin^2 \pi x + f_1 \sin^2 \frac{\pi y}{x}$, for $f_1 = 1$, $x \in [1, y]$ and $y \in [6, 8]$.