

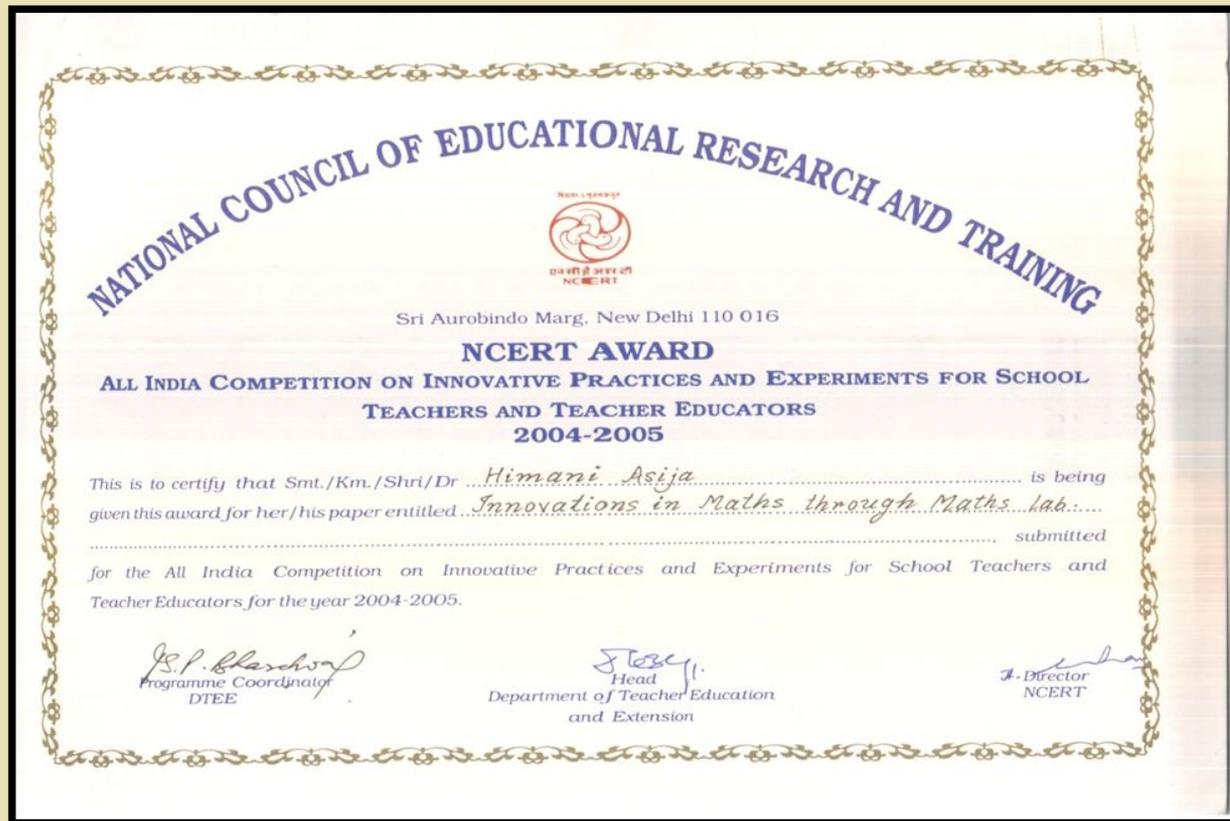
A wooden board with a blue border and a checkered pattern holds several awards. At the top left is a red ribbon with a circular emblem. Below it is a silver star-shaped medal with a central emblem. To the left is a blue ribbon with a circular emblem. Below that is another silver star-shaped medal. At the bottom left is a silver compass. A pair of gold-rimmed glasses with a thin wire bridge is placed diagonally across the board.

# MY JOURNEY FOR THE NATIONAL ICT AWARD

PRESENTED BY:  
HIMANI ASIJA  
PRINCIPAL  
AMBIENCE PUBLIC  
SCHOOL, SAFDARJUNG  
ENCLAVE

# My Professional Achievements

Awarded by N.C.E.R.T. in the “All India Competition on Innovative Practices and Experiments for School Teachers and Teacher Educators” for the paper titled “Innovations in Math through Math Lab”



# My Professional Achievements

- ◆ Recipient of the Monbukagakusho Scholarship for in-service teachers by the MOE, Japan, as a research student at Osaka Kyoiku University, Osaka, Japan for a period of 18 months.  
Research Subject : Mathematics Education  
Topic of study : Use of technology in the Teaching of Calculus  
Academic Advisor: Prof. Tomoko Yanagimoto  
Osaka Kyoiku University,  
Osaka, Japan



# My Professional Achievements: As a Mentor to my Students



## ◆ C.B.S.E. Science Exhibition

Mentoring students to work on research and investigatory projects

**Year 2009:** The research project titled “Mathematical Modelling in the a Treatment of Cancer” was a **National Level winner** through the regional level.

# My Professional Achievements



- ◆ Selected by Microsoft India for the Innovative Teachers' Leadership Award at National Level in the year 2010 to represent India at International Level in the 'Worldwide Innovative Educators Forum' at Cape Town, South Africa in 2010. The project was adjudged as the **Country Winner**
- ◆ In 2011, Selected globally by the Microsoft U.S.A. as **one of the 50 innovative teachers** to participate in Partners in Learning Institute at Washington. The programme aims at integrating the use of technology in education.

# My Professional Achievements: As a Mentor to my Students



## ◆ C.B.S.E. Science Exhibition

Mentoring students to work on research and investigatory projects

**Year 2010:** The research project titled “Simli-fly”:  
A presentation on optimization in Aviation Industry was a **National Level Winner** through the Regional levels and was chosen to participate in the reputed **“Jawaharlal Nehru Science Exhibition for Children”**

# My Professional Achievements: As a Mentor to my Students

## ◆ C.B.S.E. Science Exhibition

Mentoring students to work on research and investigatory projects

**Year 2011:** The research project titled “Fractal Horizons- the future use of fractals as new frontiers of science and mathematics” was a **National level winner** through the regional level and was chosen to participate in the reputed “**Jawaharlal Nehru Science Exhibition for Children**”. It was further chosen by N.C.E.R.T. and C.B.S.E. to participate in the **99<sup>th</sup> Indian Science Congress**.



# My Professional Achievements

Given invited talks at various conferences like NIME (National Initiatives of Mathematics Education), RFIME (Ramanujan Foundation for Initiatives in Mathematic Education), TIME (Technology in Mathematics Education) and The National Mathematics Meet at NCERT on topics such as Technology in Mathematics, Mathematical Modeling and Project Based Learning





- ◆ It was also then that I started contributing to the community- the teaching community; as a resource person to various inservice teachers' programmes at HRDC of the DPS Society.
- ◆ I also had been the Ideator of the CBSE International team of grade 6 to 8.

# Contribution to the Community



- ◆ Project head (ideator) of the CBSE i (CBSE international) team for grade 6 to 8

# Contribution to the Community



- ◆ A resource person for various workshops for in service teachers organised by CBSE/SCERT and Delhi Public School Society for the teachers teaching primary, middle and senior secondary classes on the use of technology in mathematics



# Some Projects undertaken

- ◆ Research projects
  - a. Mathematical Modelling in the diagnosis of cancer cells
  - b. Simpli-fly: an optimization model in the aviation industry
  - c. Fractal horizons: the future use of fractals in science and technology
- ◆ Investigatory projects
  - a. Aviation safety
  - b. Earth quake mechanics



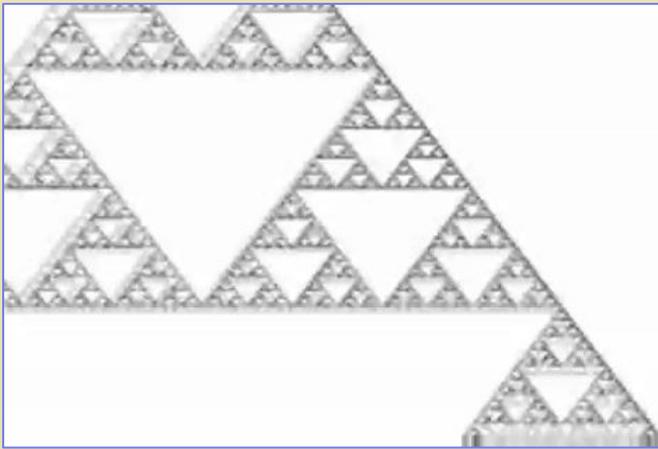
# Some Projects undertaken

- ◆ Digital lessons
  - a. Functions- a Non Mathematical approach
  - b. Role of technology in the teaching of calculus
  - c. Learning Calculus- a students' approach
  - d. Developing a math tool kit
  - e. Activities for formative assessment for middle school mathematics

# PROJECT 1: MATHEMATICAL MODELING IN THE DIAGNOSIS OF CANCER

- ◆ Process followed

Based on a holiday homework given to the students on fractals: 'Constructing and Analyzing Koch snowflake and Seirpenski's carpet'. They were supposed to draw these fractals till stage 4 and derive a relationship between the perimeters and areas at different stages and generlize the result to the nth stage.



# Mathematics of the Koch Snowflake

ITERATION	PERIMETER	AREA ENCLOSED
0	$3x$	$(\sqrt{3}/4)x^2$
1	$3(4x)/3=4x$	$(\sqrt{3}/4)x^2 + 3(\sqrt{3}/4)(x/3)^2 = (\sqrt{3}/4)x^2 (1+3/3^2)$
2	$16x/3$	$(\sqrt{3}/4)x^2 + 3(\sqrt{3}/4)(x/3)^2 + 12(\sqrt{3}/4)(x/9)^2$ $= (\sqrt{3}/4)x^2 (1+3/3^2+12/9^2)$
3	$64x/9$	$(\sqrt{3}/4)x^2 + 3(\sqrt{3}/4)(x/3)^2 + 12(\sqrt{3}/4)(x/9)^2$ $+ 48(\sqrt{3}/4)(x/27)^2$ $= (\sqrt{3}/4)x^2 (1+3/3^2+12/9^2+48/27^2)$
4	$192x/27$	$(\sqrt{3}/4)x^2 + 3(\sqrt{3}/4)(x/3)^2 + 12(\sqrt{3}/4)(x/9)^2$ $+ 48(\sqrt{3}/4)(x/27)^2 + 192(\sqrt{3}/4)(x/81)^2$ $= (\sqrt{3}/4)x^2 (1+3/3^2+12/9^2+48/27^2+192/81^2)$



## PERIMETER

The perimeters form a geometric progression with common ratio  $4/3$ , which is greater than one

$3x, 4x, 16x/3, 48x/9, 192x/27, \dots$

So, the  $n$ th term  $T_n = 3x(4/3)^{n-1}$  which increases infinitely as  $n$  increases infinitely.

Conclusion: The perimeter of the polygon approaches

infinity as  $n$  approaches infinity

**THE RATIO OF THE PERIMETER SQUARED AND AREA INCREASES INFINITELY AS THE NO. OF SIDES OF THE POLYGON INCREASES INFINITELY**

The area enclosed by the polygon forms a geometric progression with common ratio  $4/9$ , which is less than one

$(\sqrt{3}/4)x^2 (1 + 3/3^2 + 12/9^2 + 48/27^2 + 192/81^2 + \dots)$   
NOTE: The perimeter has been squared to produce a dimensionless quantity in the ratio  
 $= (\sqrt{3}/4)x^2 \cdot (1 + 1/3) = (\sqrt{3}/4)x^2 (8/5) = (\sqrt{3}/5)2x^2$   
 $\frac{1}{1 - 4/9} = 8/5$  times the area of the original

triangle

Conclusion: The area enclosed by the polygon is finite even when  $n$  approaches infinity



# MATHEMATICAL MODELING IN THE DIAGNOSIS OF CANCER

## **HYPOTHESIS – 1**

Cancer cells follow the fractal figure, the Koch Snowflake.

- ◆ The ratio of the square of the perimeter and the area ( $P^2/A$ ) of a normal cell is the least and that of the cell at the advanced stage is the maximum; it increases with the increase in the stage of malignancy.

# Hypothesis 1 : gsp snapshots

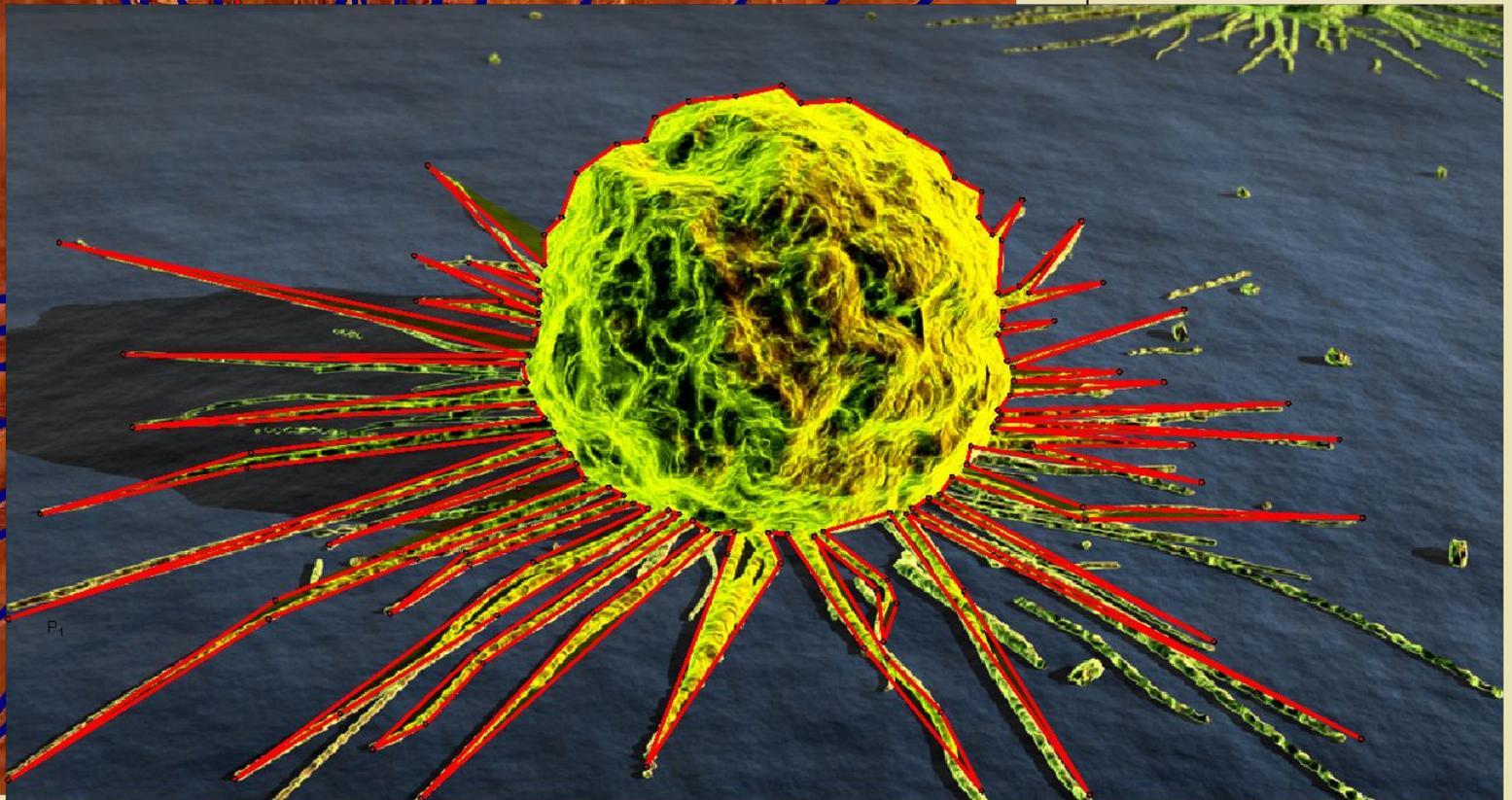
Perimeter  $P_1 = 396.60$  cm

(Perimeter  $P_1$ )<sup>2</sup> = 157293.16

Area  $P_1 = 10095.8$  cm<sup>2</sup>

(Area  $P_1$ )<sup>2</sup> = 101924166.41

Area  $P_1 = 60.48$  cm<sup>2</sup>





## HYPOTHESIS -2

THE FRACTAL DIMENSION OF THE NORMAL CELL IS MINIMUM AND IT INCREASES AS THE STAGE ADVANCES SO

HIGHER THE STAGE OF MALIGNANCY,  
HIGHER IS THE FRACTAL DIMENSION

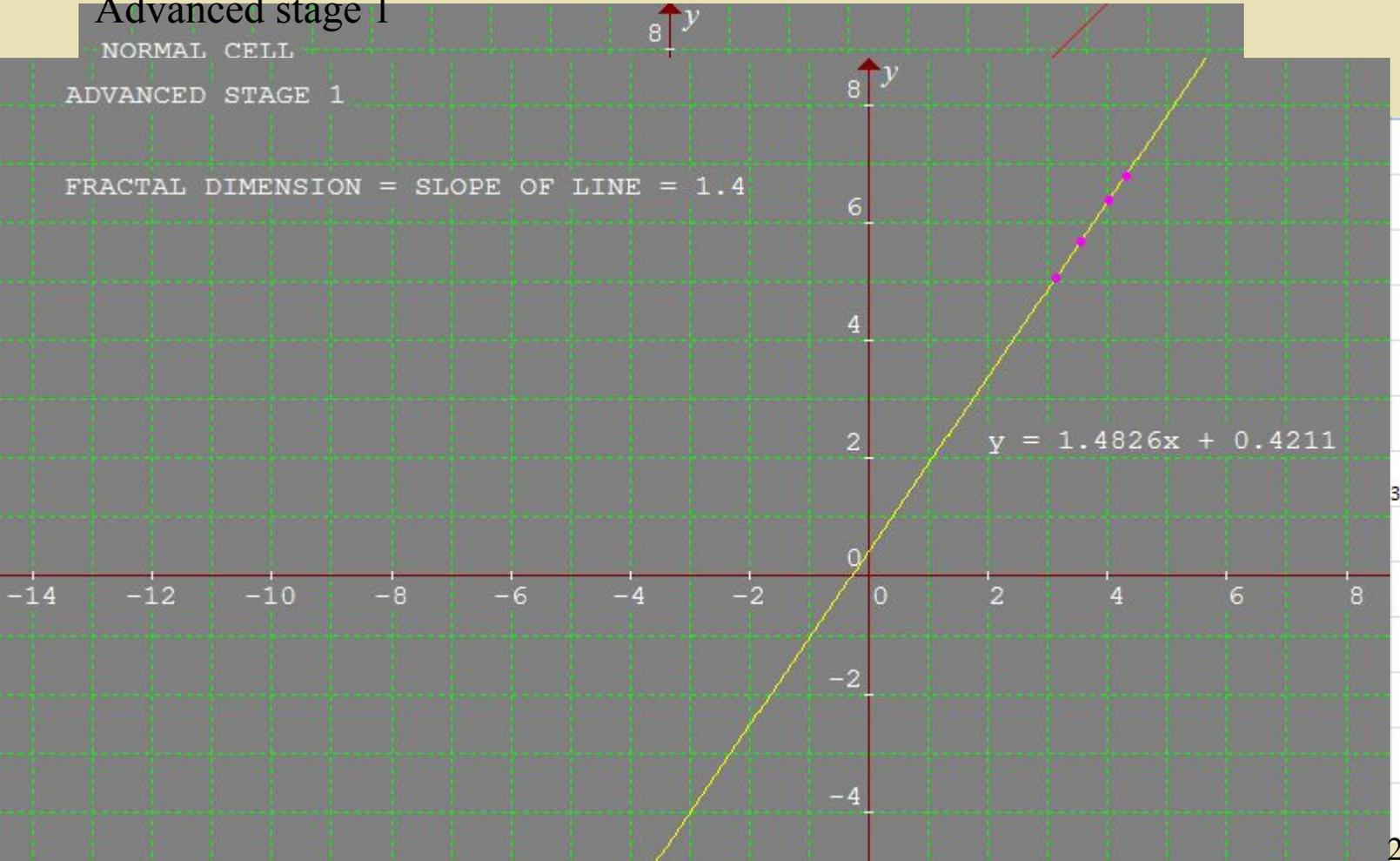
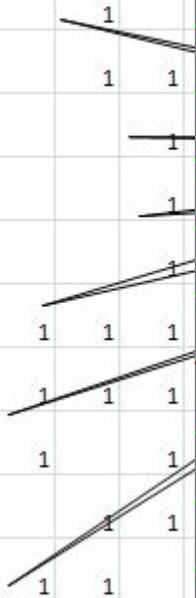
# Hypothesis 2 snapshots

Advanced stage 1

NORMAL CELL

ADVANCED STAGE 1

FRACTAL DIMENSION = SLOPE OF LINE = 1.4



# How was ICT useful to us

## mathematical modeling in diagnosis of cancer Inbox | X

My comment ★ **himani asija** Sir Please find the attached pdf of the ppt As you mentioned about the real l.. Sep 5 (1 day ago)

★ from **Raman Sardana** <ramansardana@apollohospitals.com> hide details 10:40 PM (1 hour ago) Reply

Fractal geometries in diagnosis of cancer in developing countries now.

cc **Sumaid Kaul** <sumaid\_k@apollohospitals.com>

the idea: ★ **Dr Sunita Kapoor** to me show details 10:34 PM (16 minutes ago) Reply

using the following educational material

**Mrs. Himani Asija** has done a wonderful job by putting life into the subject of **clinical application of mathematics**. The measurement of cell size and its nucleus has been the topic of hot debate in oncopathology.

- 1) Computer aided morphometry has been utilized for objectification of basic elements of a malignant cell, that is, anisocytosis, anisonucleosis and altered nucleo-cytoplasmic ratio.
- 2) This study will bridge the gap between life sciences and classroom mathematics. It could enable development of an easy and user friendly tool for diagnosing and typing of malignancy which could have far reaching consequences.
- 3) I wish her all the best in her venture.
- 4) Thanks & Regards  
Dr Sunita Kapoor  
City X- Ray & Scan Clinic  
Tilak Nagar, New Delhi  
9810061846

school: \_\_\_\_\_

their students: **Dr. Raman Sardana**  
M.D.; FMSA

Tomoko Yanagihara  
Professor of microbiology  
Osaka Kyoiku University  
Indraprastha Apollo Hospitals  
New Delhi  
With warm regards

**Raman Sardana**

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# Students' response

"I can now find that our body is governed by mathematical principles. There might be a lot more than I am aware of."

Pulkit

"How can an infinite geometric progression prove affect my life!!? Surprising!!"

Megha

"I knew about fractals as beautiful mathematical figures but never thought it was in my body too."

Mansi

## Views after the project in quotes

The students were given a questionnaire to answer before and after the presentation to test their attitude about math.   
Thought that application of mathematics was confined to commercial math, statistics and trigonometry only and that the school math we studied was just to overburden us. Now I find a lot more to explore through math

Arshiya Ojha

Views before the project in quotes   
I can now find that our body is governed by mathematical principles. There might be a lot more than I am aware of."

"Math can be used in fields like Trigonometry, Commercial Math, Statistics"

Pulkit Jaiswal

"I knew about fractals as beautiful mathematical figures but never thought it was in my body too."

*Almost everybody gave this statement*

"Calculus is used in physics which has a lot of practical use"

"How can an infinite geometric progression prove affect my life!!? Surprising!!"

*Pulkit Jaiswal (student)*

"Parabolic reflectors are based on parabolas"

I can understand that there are a lot of applications of math in our lives, a lot more than we are aware of. I would like to explore them."

*Mansi (student)*

Shuchita

"I think whatever we study in math, each and every topic however abstract it might seem, has a real life application."

Anirudh



Area  $P_1 = 7.89 \text{ cm}^2$

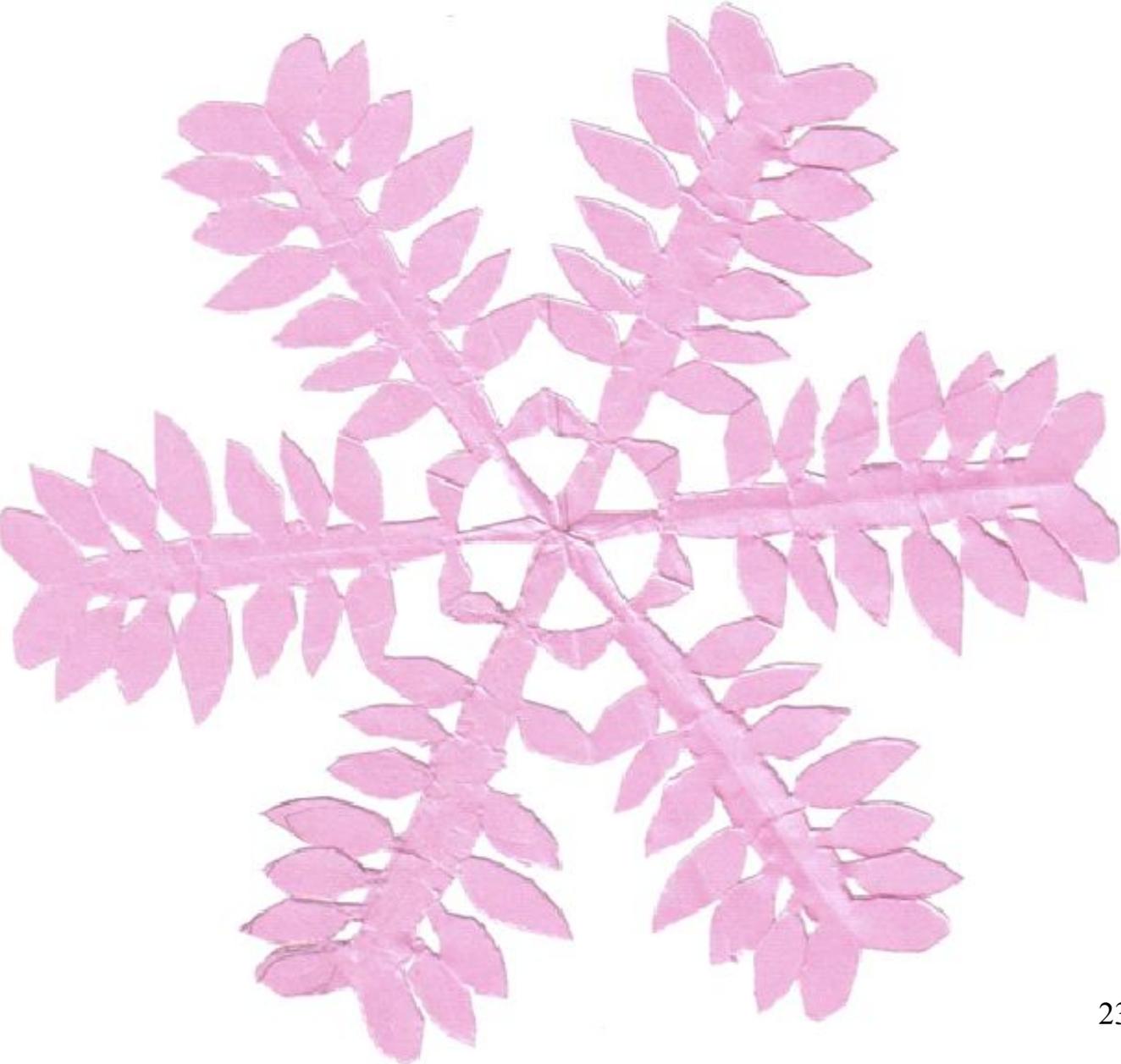
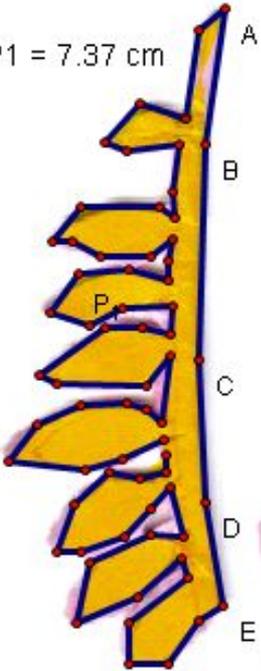
Perimeter  $P_1 = 39.49 \text{ cm}$

SUBTRACT FROM  $P_1 = 7.37 \text{ cm}$

$P = 385.54 \text{ cm}$

AREA =  $94.68 \text{ cm}^2$

$$\frac{P^2}{\text{AREA}} = 1569.87$$



# Project 2

## Fractal Horizons : Future use of Fractals as new frontiers of Science and Mathematics

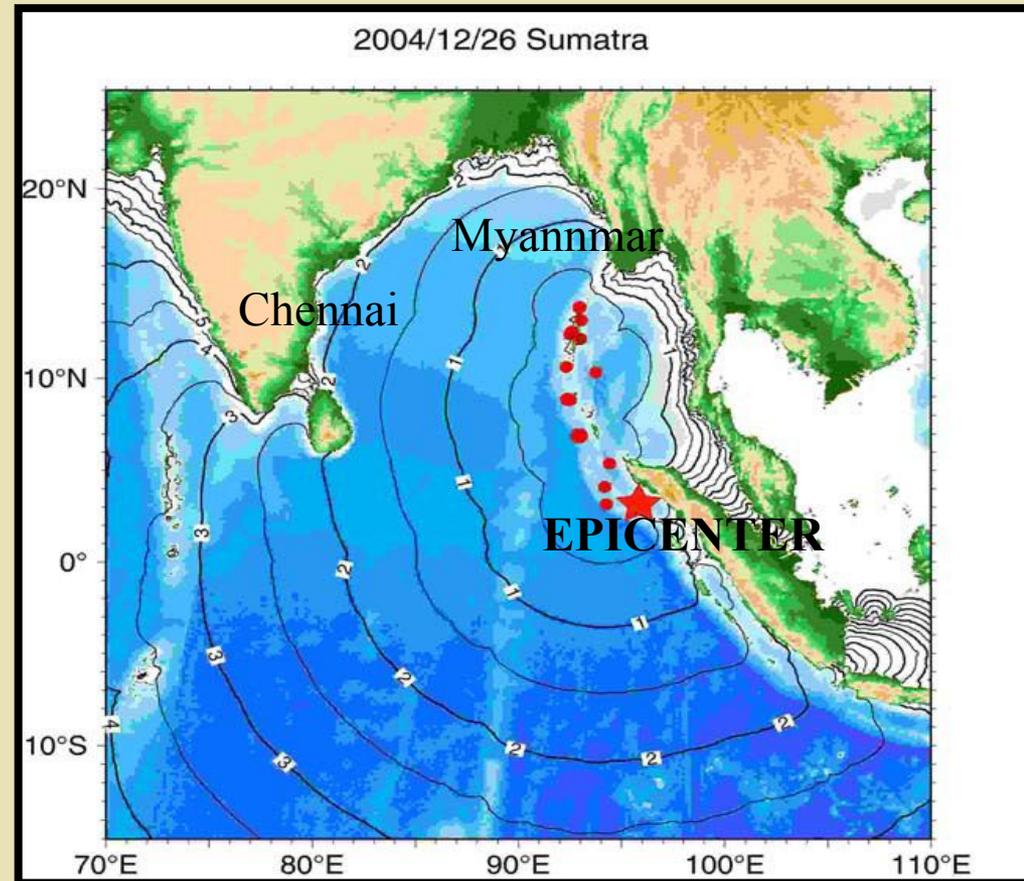
### ◆ Hypothesis

More the fractal nature of the coastline, more is its ability to dampen wave heights and thus, lesser are the Tsunami wave heights on the coastline.



# The 2004 tsunami

Various coastlines were hit by the same wavelets originating from the epicentre but wave heights were different for different coastlines i.e. places which were almost at the same distance from the epicenter and received waves from the same wavelet had varied wave heights. Eg. Chennai and Myanmar are almost at an equal distance from the epicenter but wave heights were much greater at Chennai than Myanmar.



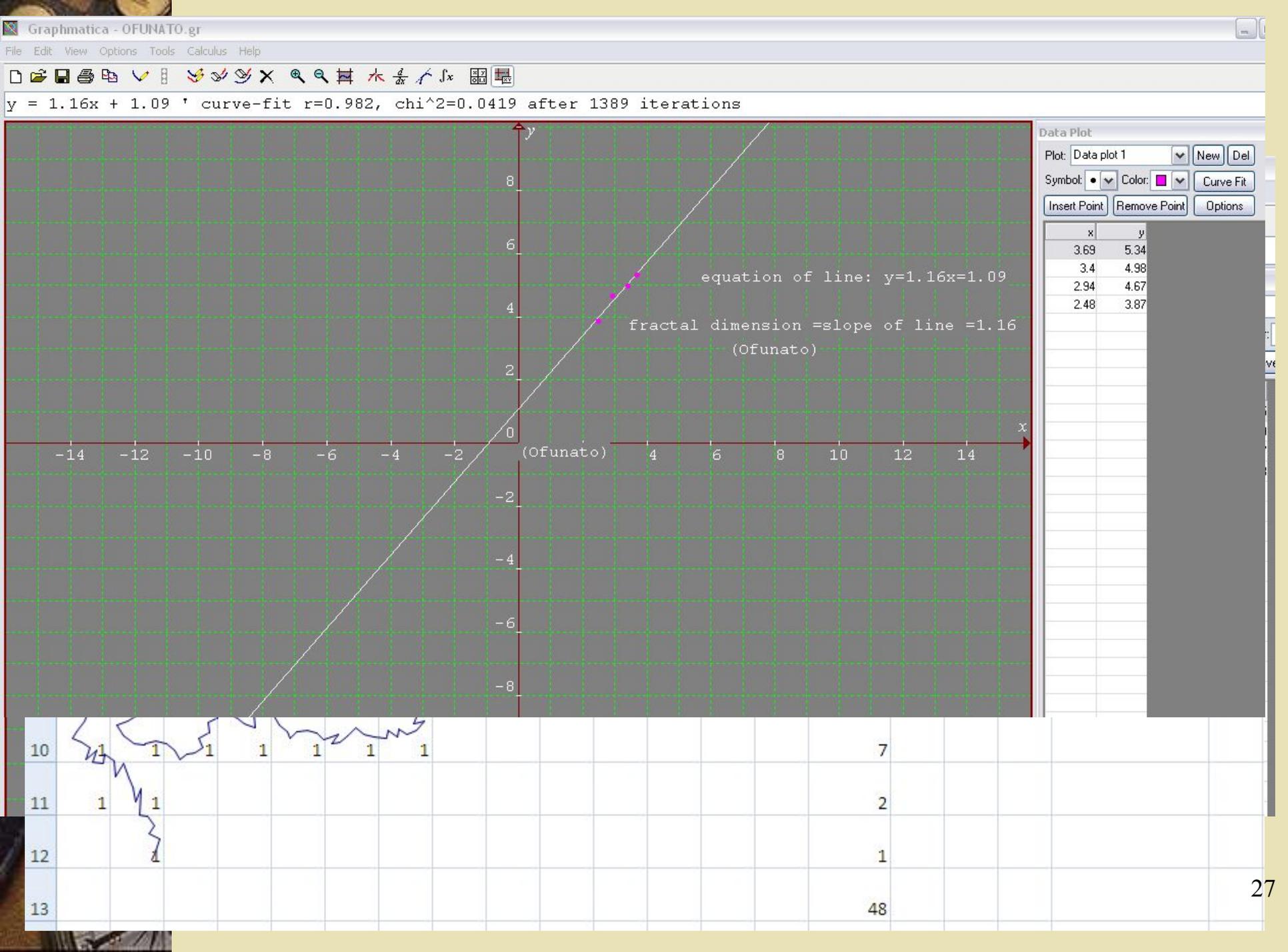
# The 2011 tsunami

Similarly, various areas on the Japanese coastline received varied wave heights.

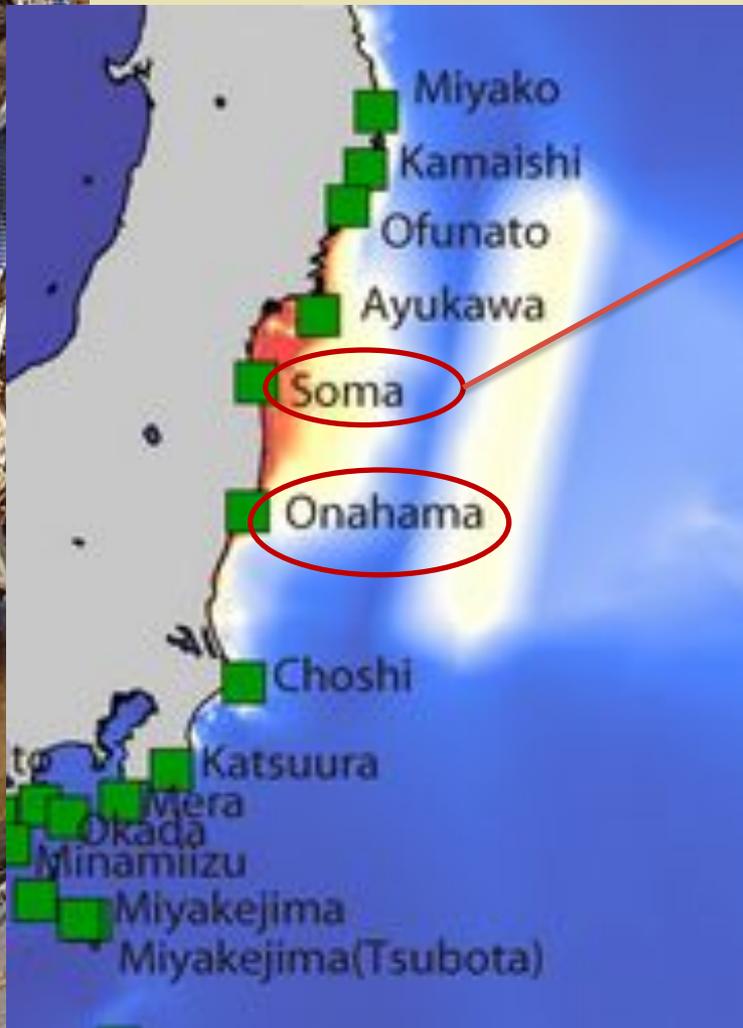


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# DATA ANALYSIS



- ◆ As we can see that Onahama is on the periphery of the red region (worst hit region) it should have had lower wave heights than Soma (in the worst hit region), but wave heights are almost same for both. Fractal dimension of Onahama is 1.15 and Soma is 1.17. There is a difference of 0.02 in their fractal dimensions which is huge as fractal nature increases exponentially in the range of 1.1 to 1.2 i.e. a small increase in the fractal dimension corresponds to a large increase in fractal nature (according to fractal geometry).

# SUMMARY

COASTLINE	WAVE HEIGHTS (from US Geological Survey)	FRACTAL DIMENSION(as calculated above)	Analysis
Chennai (2004)	4.8m	1.03	Myanmar has more fractal nature so it received waves of lesser heights as compared to Chennai.
Myanmar(2004)	approximately 2m	1.43	
Ofunato(2011)	11-13m	1.16	Miyako had lesser wave heights as compared to Ofunato as the fractal dimension and thus fractal nature of Miyako is more.
Miyako(2011)	8-10m	1.24	
Onahama(2011)	just below 20	1.15	Soma, as discussed above is in the worst hit region so it is expected to have a higher wave height as compared to Onahama but it was almost the same as that of Onahama as the fractal dimension of Soma is more than Onahama.
Soma(2011)	approximately 20	1.17	



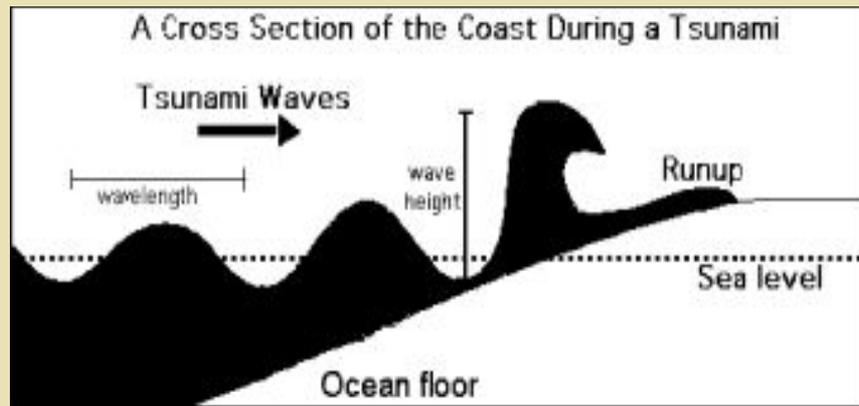
# Conclusion

- ◆ Thus we conclude that more fractal the nature of the coastline, greater is its dampening effect on waves and thus, lesser are the Tsunami wave heights on that coastline; i.e. if two coastlines are almost at an equal distance from the Tsunami epicenter and they receive waves from the same wavelet, the coastline which is more fractal in nature will have lesser wave heights.

# IS THAT ALL THAT AFFECTS THE TSUNAMI WAVES?

## ◆ The ocean floor size

The amplification of the tsunami waves depends on the run up of the ocean floor. This is because the fractal nature of the surface coastline resolves into the ocean floor. Now when the waves interact with the ocean floor which is fractal in nature, they get diffracted, which leads to multiple in phase and out of phase retentions, which when averaged give a less amplification than when the waves don't get diffracted.



☆ **Phòng chuyên trách** Phòng Chuyên trách Trang thông tin điện tử Viện KHCNVN xin thông báo: Bạn vừa... Oct 4

☆ **D Shankar** to me [show details](#) Oct 10 (10 days ago) [Reply](#)

☆ **Nikhil Pawar** to me [show details](#) Sep 20 [Reply](#)

Hi Megha,

I took a good look at the presentation you had sent me. I have to admit, I was thoroughly impressed. It was much better than what I was expecting :) I really enjoyed it.

You have done really well in explaining your methodology, you have presented multiple data sets, proposed hypothesis and tested them! This is exactly how good research papers are presented. Excellent work. Being rigorous and giving a lot of attention to detail is essential in science and you seem to have understood that. Keep it up.

If I had to suggest areas of further improvement from the research completeness point of view, I would suggest developing a theory to explain why the result that you obtained is the way it is. You concluded that more the fractal nature, more is the dampening and hence lesser is the wave height. A really good research **paper** will try and explain why that is. Not all research papers do this. In fact most stop at where you have stopped. But the really good researchers will always try and embed a theory along with their results.

Another point is a possible acknowledgement of other work that may be done in this field. That is generally summarised at the beginning. It is commonly called the literature review. Here you look at what work other people have done in this area, what they found and how that may influence the work you are doing. This is esp important so that you dont end up simply repeating the work someone else has done.

Having said that all these points are what a PhD student would be told :) For you to reach this level at this early a stage is really commendable. You are doing really well. Do send me copies of any further work that you do.

Bests  
Nikhil

D. Shankar  
National Institute of Oceanography,  
Dona Paula, Goa 403004,  
India



# MY FUTURE VISION

- ◆ To integrate education with technology and to take it to the masses
- ◆ To find out the cross curricular links of different subjects so that no subject is taught divorced from each other
- ◆ To bring the classrooms to the masses through web seminars
- ◆ To collaborate with teachers over the globe and present the expertise to the world



THANK YOU