IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⋇ Peer-reviewed / Refereed journal ⋇ Vol. 10, Issue 10, October 2023

DOI: 10.17148/IARJSET.2023.101004

Applying Green's Theorem to determine Growth of Annual Lines of a Plant

Sourjya Gupta

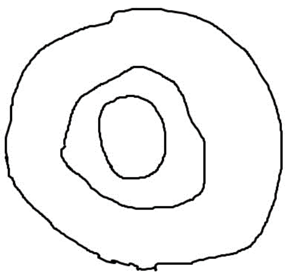
Student, Civil Engineering, Techno India University, Kolkata, India

Abstract: By applying the Green's theorem on a simple mathematical model. I intend to find the nature of growth of the annual rings of a plant. Though this paper has taken ideal cases and is just an approximation. The insight of the paper is purely mathematical.

Keywords: Greens theorem, annual rings, cross section, stem

I. INTRODUCTION

We start by taking a system in which we take an arbitrary formation of annual line in some stem. By taking a centre of the stem, we measure the distance from the centre to a point on the annual line. We define each components taken as a vector.



The girth of a tree increases by distance s.

Here, $\vec{s}$ is taken a vector quantity. The point on the annual line moved from the centre by distance $\vec{s}$ in a certain direction on the 2-D plane (cross section of the stem).

$\vec{r}$ is a small vector taken on the curve of the annual ring. Where r is an element of a line.

Say the angle made by the line from the centre of the stem to the point of which we are measuring the growth and at a tangential distance r from the point is θ.

Thus,

$\vec{r} = \vec{s}\ tan\theta$

The differential is,

$d\vec{r}\ = d\vec{s}tan\theta$

DOI: 10.17148/IARJSET.2023.101004

As $\vec{r}$ is an element itself,

$$d\vec{r} = \vec{s}dtan\theta$$

From Green's theorem we can say,

$$\oint \vec{s}dtan\theta \,.\vec{r} = \iint \nabla \times d\vec{s}\,.dA$$

Above we define the function, which now can be operated with the Green's theorem

Now we see,

$\vec{s}.\vec{r} = 0$ As, $\vec{s}$ and $\vec{r}$ are perpendicular

Hence,

$$\iint \nabla \times \vec{s}\,.dA = 0$$

The 2-D curl of $d\vec{s}$ is,

$$\iint \frac{\partial \vec{f}}{\partial y} - \frac{\partial \vec{g}}{\partial x}\,.dA = 0$$

As dA cannot be 0,

$$\frac{\partial \vec{f}}{\partial y} - \frac{\partial \vec{g}}{\partial x} = 0$$

II. CONCLUSION

Hence one family of solution is f is only a function of x, f(x) and g is only a function of y, g(y).

Hence we observe the growth of the annual rings over the y axis is only dependent upon the value for y in the given point, while we observe that the growth in x direction is only dependent on the value for x in the given point.

Now this be our first interpretation. There is also a possibility of $\frac{\partial \vec{f}}{\partial y} = \frac{\partial \vec{g}}{\partial x}$

Now if we consider this possibility, we know about the infinite possibilities of the solution of f and g, that may be both dependent on x and y.

However, we can conclude the nature of growth of the annual lines in the plant by a simple property of mathematics. We have arrived at a possible partial differential equation that may guide the above phenomena.

REFERENCES

[1]. *Riley, K. F.; Hobson, M. P.; Bence, S. J. (2010). Mathematical Methods for Physics and Engineering. Cambridge University Press. ISBN 978-0-521-86153-3.*

[2]. Britannica, The Editors of Encyclopaedia. "annual". Encyclopedia Britannica, 17 Jan. 2023, https://www.britannica.com/science/annual. Accessed 27 October 2023.S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, "A novel ultrathin elevated channel low-temperature poly-Si TFT", *IEEE Electron Device Lett.*, vol. 20, pp. 569–571, 1999.

[3]. Britannica, The Editors of Encyclopaedia. "partial differential equation". Encyclopedia Britannica, 28 Sep. 2006, https://www.britannica.com/science/partial-differential-equation. Accessed 27 October 2023.