A detailed analysis of geometry using only two variables.

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November 16th 2016

Abstract

Calculating certain aspects of geometry has been difficult. They have defied analytics. Here I propose a method of analysing shape and space in terms of two variables (n, m).

I. Introduction

Detailed here is the general notion of what (m_i, n_i) is. It is essentially a grouping of ideas that emanate from applying two variables m and n to the forms of matrices, i.e., grids. For a random shape, embedded in a grid and denoted by the coordinates (m, n), this can be represented by a set as coordinates where m is the first continuous row and n is the first column and so on. For a simple, symmetric shape such as spheres or cubes we have $\frac{\delta m}{\delta n} = 1$. Then the size of the shape is given by the horizontal (m) distance the shape traverses, denoted by T. The vertical distance (n) is symbolised by S. For a symmetric shape we have $\Sigma m = \Sigma n$. Also regarding the slope we have $\frac{i}{j} = \frac{m}{n}$. When determining the position of a row or column in regard to a function describing the curve that the rows/columns follow we have $f(m) = n$. Thus, to find a position just employ this equation.

$$f(m) = 2m$$

Knowing any number of rows and columns specifies the position of the element. Also (m_i, n_i) can be used to state the number of elements to be added or subtracted to the matrix. m means the number of rows to add to the matrix and n means the number of columns to

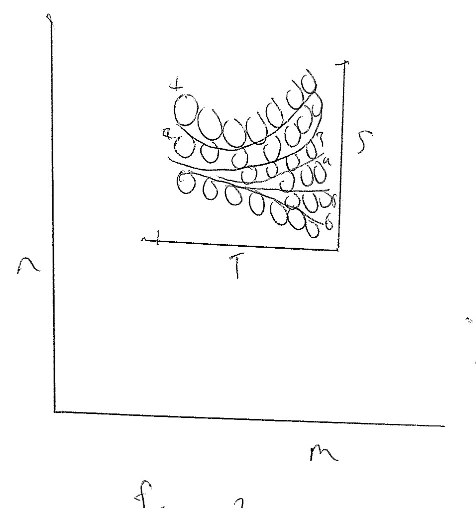

Figure 1: *For a given distribution in a geometry we have T and S representing the grid coordinates (m, n)*

*A thank you or further information

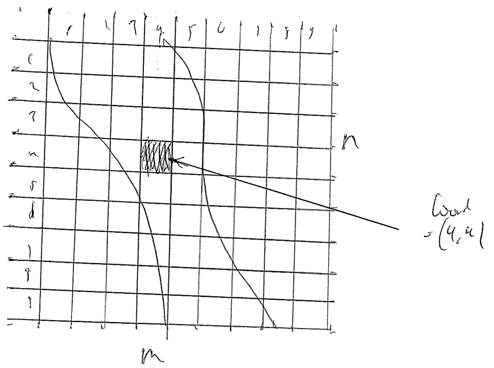

Figure 2: *In this diagram the shaded cell is located at (4,4)*

be added, i.e., $a_{ij} = [a_{11}]$ then use the operator $[m, n] = [2, 2]$.

$$[m, n][a_{ij}] = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$$

this can be manipulated to add or remove any number of rows/columns. Also $[m, n][3, 3] + [m, n][-3, -3] = [0]$ generally $[m, n][a, b] + [m, n][-a, -b] = 0$. In regards to multiplication we have $[m, n][a, b]X[m, n][c, d] = 2(m, n)$ if $a = c, b = d$. The rate of change of rows and columns with respect to themselves is:

Generating functions for (m, n) can be basically any function, i.e., $f(m) = 2m$ The velocity of "shapes" described by the (m, n) grids is simply $V_n = \frac{n+n_i}{t}$, i.e., if a shape moves by n_i units along one axis we have the velocity for a given time period. If the geometry is multiplied by a constant c we have $c/t = V$. If $f(x)$ "grows" the geometry then the velocity is $f(x)/t$. When generating patterns using Newton's Method we have $y - fn = f'(n)(x - a)$. If the geometry is the shape of a sphere then by calculating the circumference and the number of rows we can calculate the circumference $C = \pi d$ then the row size is $\frac{\pi d}{n}$

$$C = \pi D$$

Size of a row

$$= \frac{\pi D}{n}$$

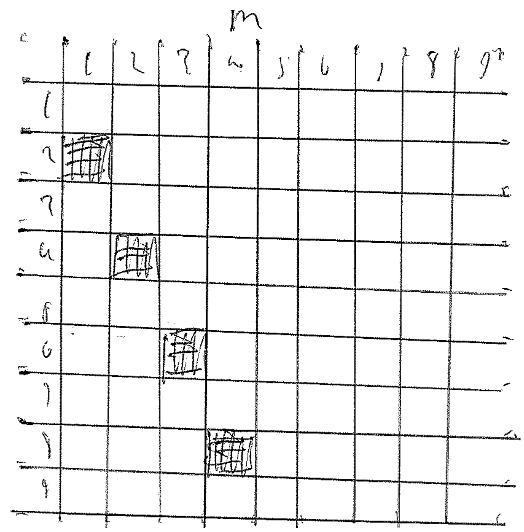

Figure 3: *The results of applying $f(m) = 2m$*

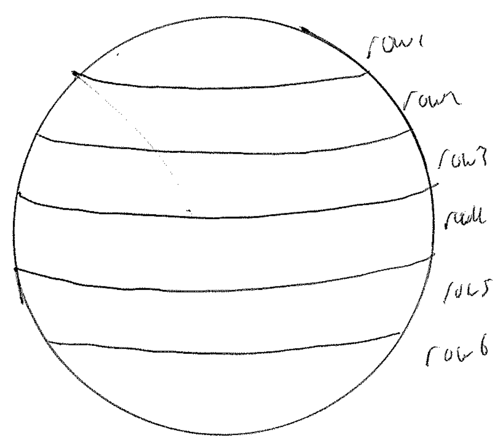

Figure 4: *The size of rows in a circle*

In regard to the rank as a tensor we have T_{mnr}. A rank 2 matrix can be turned into rank 3 by 'curving' the grid.

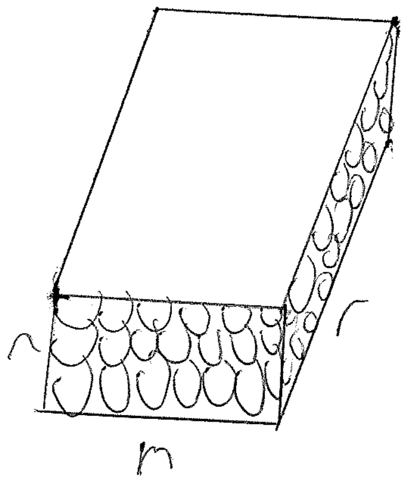

Figure 5: *Figure 5: T_{mnr} If we "curve" the flat grid we can produce a rank 3 tensor*

Density is given by $\rho = \frac{\text{number of occurences}}{\text{Total number of elements}}$. This is equal to $\frac{\Sigma i}{n}$. Now for an aside. This is a sketchy proof that every point in the grid contains "something". That is in reality there is no such thing as an empty grid.

$$\int_a^b o = \int_a^b dm - dm$$

Let $dm = m_2 - m_1 = \int_a^b dm - (m_2 - m_1)$ and $m_2 = 0$, $\int_a^b dm + m1$ and $\int_a^b m1 = c$. Therefore every element contains something. In terms of polar coordinates we have:

$$ds^2 = dr^2 + r^2 d\theta^2$$

$$A + B = 2 \text{ when } A = B$$

$$A + B + C = 3 \text{ when } A = B = C$$

In regards to tensors, for a general grid we have $ds^2 = \delta(m,n)dx^u dx^v$. For adding two shapes we have $A + B = 2$ if $A + B$. We have $A + B + C = 3$ if $A + B + C$ and so on. Specifically we have $(m_i, n_j) + (r_i, s_j) = (m_i + r_i, n_j + s_j)$

$$\varphi = \theta_1 r$$

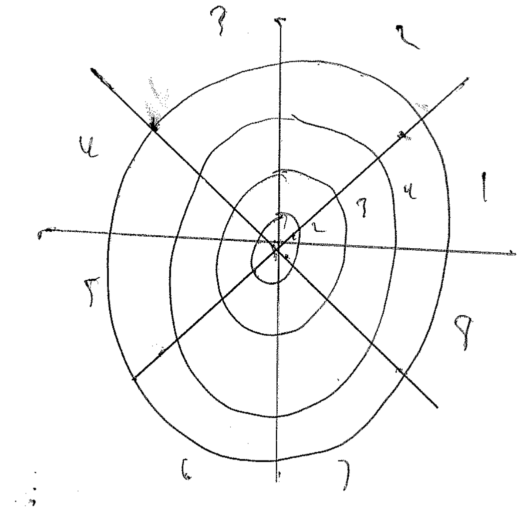

Figure 6: *The flat (m,n) grid can be represented by polar coordinates, the information is essentially the same.*

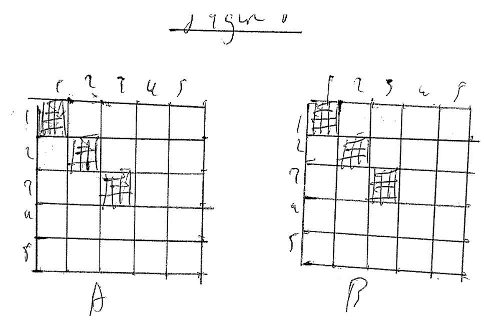

Figure 7: *For further work if two or more shapes are repeated they produce an integer value*

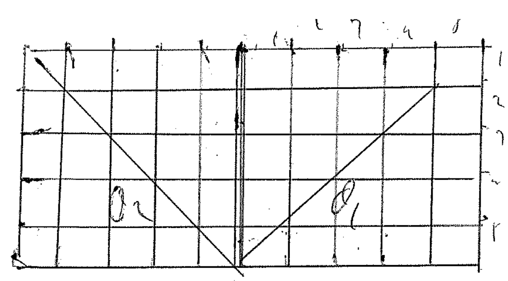

Figure 8: *Figure 9*

When determining the angle to point to the furthest point on the shape from the origin, we have $0 \leq f(\theta) \leq 2pi$ if $f(m,n) = g(m,n,t)$, which depends on time. Then we can equate this with $g(m,n,t) = \sigma m, n$. To determine the facets of a shape we take the enclosing boundaries T, S the distance from this origin to the furthest point, the angle θ and also how many cells the shape takes up and the volume of those cells. Also a function's segments are equal to the radius r times the angle θ, i.e., $\Sigma ri\theta i = f(mi, nj)$. The angle θ can be found by $\tan(\theta) = \frac{n-f(n)}{m-f(m}$.

$$\theta = \tan^{-1}\left(\frac{n-f(n)}{m-f(m)}\right)$$

Then $\Sigma r_i \theta i = f(m,n)$. The "grid" can be distorted by the simple formulae $a_m = 1/m$ and $a_m = m$. This can be extended to any formula for a given value of the spacing

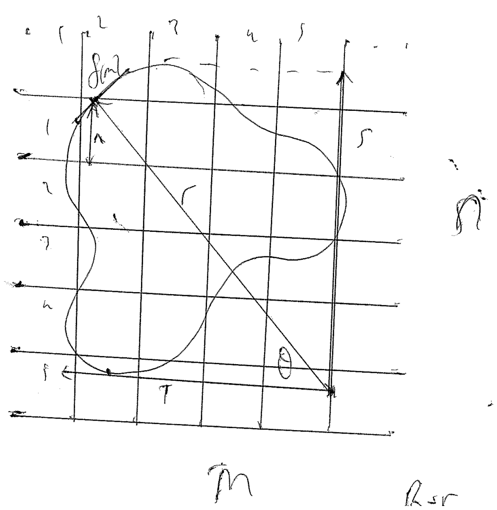

Figure 9: *The "radius" to the furthest point and its associated angle.*

$$R = r$$

$$a_m = \frac{1}{m} \qquad a_m = m$$

in general $a_m = f(m)$ The (m,n) theme can be extended to polar coordinates.

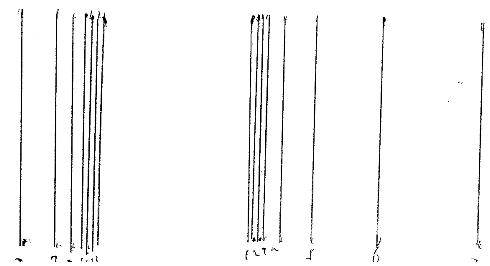

Figure 10: *The spacing's of the grid can be represented by a function*

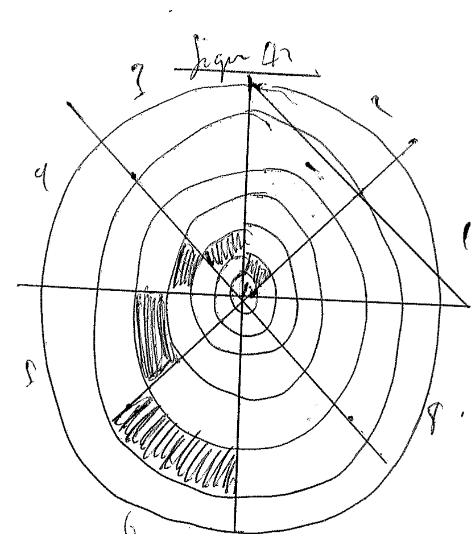

Figure 11: *The grids can be written as polar coordinates where the corresponding (m,n)'s are shown*

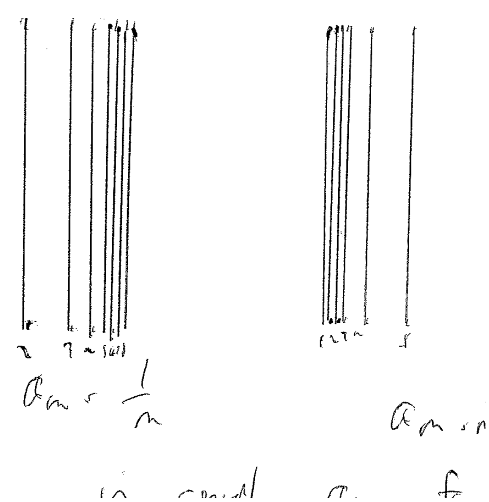

Figure 12: *Some simple functions showing spacing's of the grids*

$$(a_m, a_n) = (a_{ii}, b_{ii})$$
$$\{(1,1)(2,2)(3,3)(4,4)\dots\}$$

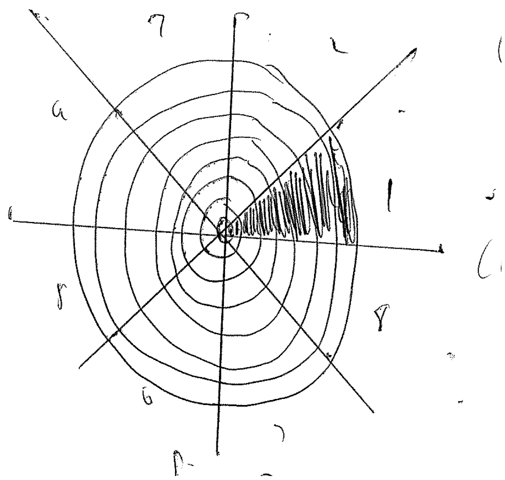

Figure 13: *Where* $(m, n) = (1, a_i)$

$(a_m, a_n) = (1, a_i) = \{(1,1)(1,2)(1,3)(1,4)(1,5)\}$
Trajectories can be denoted by "links".

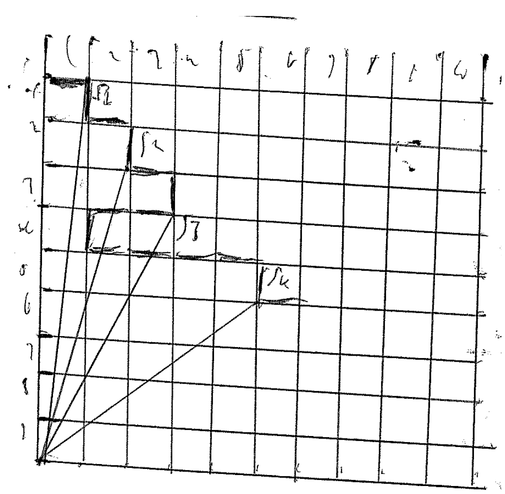

Figure 14: *A trajectory can be represented by 'links' where* $S_i = R_i\theta i$

The geometry of a single cell can re-represented by the following diagram. A curious case is when $\tan(\theta) = \tan(\phi)$

$$\tan\theta_i = \left(\frac{m - x}{n}\right)$$

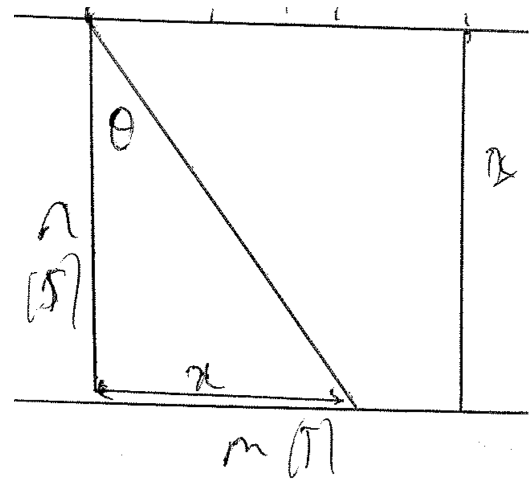

Figure 15: *Figure 14*

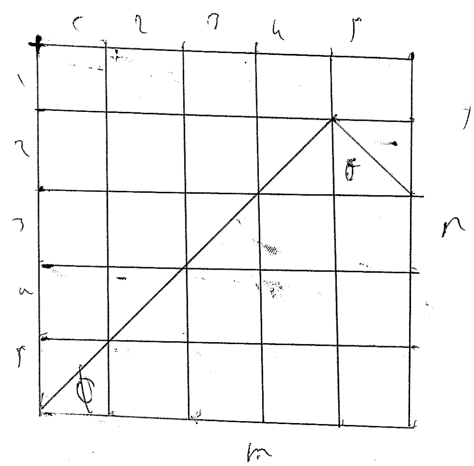

Figure 16: *Figure 15*

$$\tan(\phi) = \tan(\theta)$$

To begin the point of this article we have simple sets denoting operators, i.e., in the above diagrams we could denote the information about the shapes by $\{R, T, S\}$. This can also be denoted by Ket vectors

$$
\begin{aligned}
T|\phi >&= \text{horizontal distance}\\
S|\phi >&= \text{verticasl distance}\\
\Phi|\phi >&= \text{angle for } R\\
a+|\phi >&= \text{number of cells}\\
A|\phi >&= \text{area of cell in question/ area of } TS\\
R|\phi >&= \text{radius}
\end{aligned}
$$

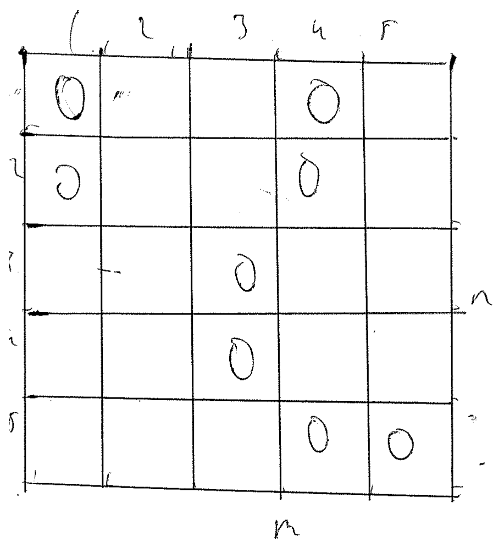

Figure 17: *A distribution of* $\frac{\Sigma(m,n)}{mn} = \rho =$ *density of occurences.*

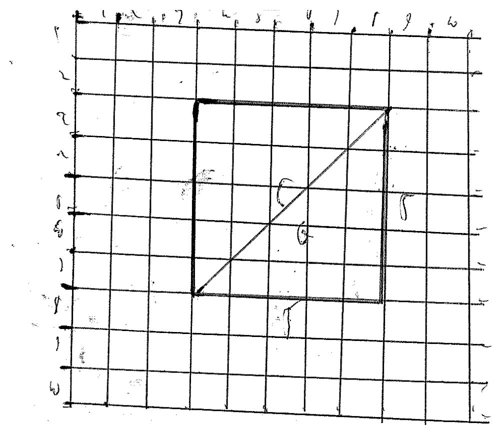

Figure 18: *The R, θ,S and T of building the sets.*

$$\rho = \frac{a_i}{mn}$$

$$
\begin{aligned}
R &= 3\\
\theta &= \frac{\pi}{4}\\
r &= 5\\
T &= 5
\end{aligned}
$$

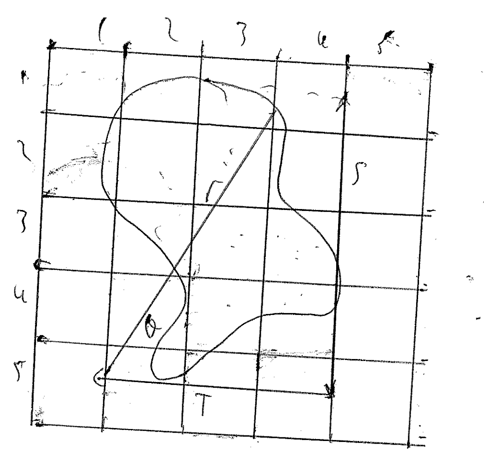

Figure 19: *A random shape and how it can be captured*

Set $\{R, T, S, \phi, a^+, A\}$

$$
\begin{aligned}
R &= 8.5 \text{ cm} \\
T &= 6.5 \text{ cm} \\
S &= 8 \text{ cm} \\
\phi &= \frac{\pi}{4} \\
a^t &\approx 6 \\
A &= 4 \text{ cm}
\end{aligned}
$$

In the following diagrams, we see the elegance of the set. We can apply it to individual elements to determine their geometry then apply these again to the set to supply information about the shape, i.e., $L \circ K = C$ where L is one set (large scale) and K is another set (small elements). In regard to probabilities we have $\Phi * \Phi = P = \Sigma(m,n)/m_n$. The main beauty of the set $[R, T, S, \phi, a+, A]$ is that it can be applied to itself. That is on small elements to determine larger shapes. It can also be used as a quantum operator $RTS(\phi)a + A|\Phi >$.

For larger shapes we have

$$
\begin{aligned}
T &= \Sigma(T_n) \\
S &= \Sigma(S_n) \\
R &= R_n \\
A &= \Sigma A_n \\
a+ &= n \\
\phi &= \theta n
\end{aligned}
$$

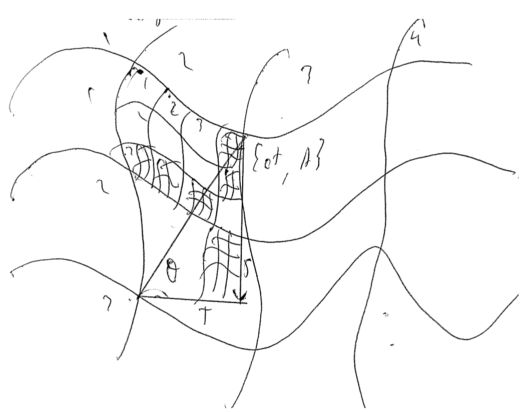

Figure 20: *Curvi-linear coordinates and empty cells can be subsumed*

$$
\begin{aligned}
\bar{X} &= \{R, T, S, \phi, a+, A\} \\
\bar{y} &= \min(m)\min(n)i, \min(m)\max(m)i
\end{aligned}
$$

This finds the highest and lowest points for each row and column (summing over i) $\bar{X}|(a_1, b_1), (a_2, b_2), (a_3, b_3), (a_4, b_4) \ldots >= \Sigma[R, T, S, \phi, a+, A]$

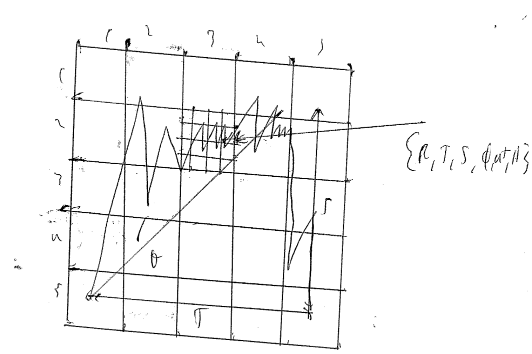

Figure 21: *By 'zooming in' and applying the set repeatedly a full picture can be obtained.*

Now we introduce the operator W which produces a coordinate from $[R, T, S, \phi, a+, A]$, i.e., $W \circ \{R, T, S, \phi, a+, A\} = (m, n)$ This operator has to be determined from knowledge of the neighboring elements. Furthering this say, we have a matrix A.

$$
A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}
$$

Then $\Pi A = \{(a_{11}, a_{13}), (a_{23}, a_{22}) \ldots\}$ which can all be possible combinations of A. Then the matrix β chooses 'points' from this matrix, i.e., $B\Pi$ a element of ΠA

To find the value of a function contained within the operator, we have $\tan(\theta) = S/T = n/m$. $f(m) = n = \Sigma T_i \tan(\theta)$ or $f(m) = \Sigma S_i$ $f(m) = \frac{\Sigma S_i}{\Sigma T_i} = \tan\theta_i$. Therefore $f'(m) = \sec^2(\theta)$

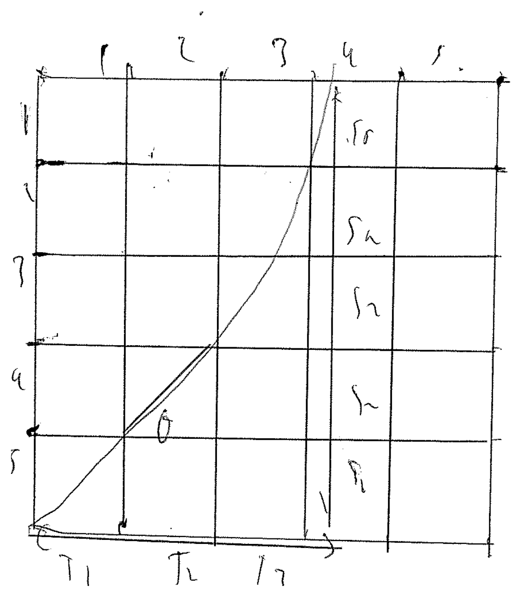

Figure 22: *Evaluating a curve using the (m,n) grid*

$$\tan\theta = \frac{S}{T} = \frac{N}{m}$$
$$f(m) = \sum_{i=1}^{w} T_i \tan\theta$$
$$= \sum S_i$$
$$f(m) = \frac{\sum S_i}{\sum Ti}$$
$$\therefore f'(m) = \sec^2\theta_i$$

We can also have a "scale factor", $\bar{X} = a(t)\{R, T, S, \theta, a+, A\}$. This grows the entire shape, perhaps producing spheres when the angle revolves. The operator can be used as a substitute for tensors as the metric $g_{uv}(dx^u dx^v) = T^2 + S^2$.

For higher dimensions we have $\bar{n}\bar{x} = [\sum T^2, \sum S^2 ...]$ As the metric, where the square root is taken to produce a value. We cannot however do this for the angle θ. This however is a matter of notation. The product $\bar{x}\bar{x}$ could be used in a similar manner to the dot product.

References

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[4] Figueredo, A. J. and Wolf, P. S. A. (2009), *Assortative pairing and life history strategy – a cross-cultural study.* Human Nature, 20:317–330.