One dimensional method for Clifford analysis

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Abstract: Unlike Dirac operator method, this paper discusses one dimensional method for Clifford analysis, namely the n-dimensional problem is simplified into n problems of one dimension, even reduced to only one problem of one dimension. For example, the typhoon track is a two-dimensional problem related to latitude and longitude, but as forecasting typhoon track, it can be simplified into two problems of one dimension: forecasting longitude and forecasting latitude respectively. Again, the stock index is effected by various factors, however as forecasting stock index we may assume that it is only a function of time. In order to improve the effect of one dimensional method, we can change finding the solution suitable for whole space or a domain, into finding the solution suitable for one point only with single point method. As applying one dimensional method, the fractal model is very effective.

Key words: Clifford analysis, one dimensional method, single point method, fractal model

Introduction

As well-known, Clifford analysis is a generalization of complex function theory in higher dimensions, for the case of four-dimension, it is the Quaternion analysis. At present, Clifford analysis mainly focuses on the study and application of Dirac operator. For some problems, different from that of Dirac operator, this paper discusses one dimensional method for Clifford analysis, namely the n-dimensional problem is simplified into n problems of one dimension, even reduced to only one problem of one dimension.

1 Simplifying n-dimensional problem into n problems of one dimension

Obviously, to compare with the n-dimensional problem, the problem of one dimension is very easy and simple.

For example, the typhoon track is a two-dimensional problem related to latitude and longitude, but as forecasting typhoon track, it can be simplified into two problems of one dimension: forecasting longitude and forecasting latitude respectively.

Now, we will forecast the longitude and latitude of typhoon track respectively with fractal method.

Recently, fractal method has been successfully used in many fields, and it is used for finding out the deeply hidden organized structure in complex phenomena. The quantity for reflecting the character of organized structure is called the fractal dimension, expressed with the value of D. In the fractal methods for general application at present, the fractal dimension D is a constant. For example the values of fractal dimension D for different coastlines may be taken as 1.02, 1.25 and so on. The fractal model[1] reads

$$N = \frac{C}{r^D} \qquad (1)$$

where r is the characteristic scale, such as time, length, coordinates and so on; N is the object number or quantity related with the value of r, such as output, price, temperature, the value to be predicted and so on; C is a constant to be determined, D is the fractal dimension.

In the recent application of fractal method, D is the constant, may be called constant dimension fractal. It is a straight line in the double logarithmic coordinates. According to arbitrary two data points (N_i, r_i) and (N_j, r_j) on this straight line, the fractal parameters of this straight line, i.e., the fractal dimension D_{ij} and the constant C_{ij}, can be determined; Substituting the coordinates of the two data points into Eq.(1), they can be solved

$$D_{ij} = \frac{\ln(N_i / N_j)}{\ln(r_j / r_i)} \qquad (2)$$

$$C_{ij} = N_i r_i^{D_{ij}} \qquad (3)$$

For the straight line functional relation in the double logarithmic coordinates, it is able to process prediction and calculation with the constant dimension fractal directly.

But for the non-straight line functional relation in the double logarithmic coordinates, it is unable to process the prediction and calculation with the constant dimension fractal. Many questions belong to this situation. In order to overcome this difficulty, the concept of variable dimension fractal in references [2] ~ [4] is introduced, namely the fractal dimension D is the function of characteristic scale r .

$$D = F(r) \qquad (4)$$

Now we discuss how to carry on prediction and calculation with this fractal model.

For the sake of convenience, let r denote the serial number of time, it will stipulate some year for the first year, then $r_1 = 1$, for the second year, $r_2 = 2$, and so on. Let N denote the given value and the value to be predicted, for example, taking N_1 as the value of the first year, N_2 as the value of the second year, and so on.

Now supposing that n data points are given, the values for the first year to the n^{th} year are known, thereupon the question becomes how to predict the values for the $(n+1)^{\text{th}}$ year, $(n+2)^{\text{th}}$ year and so on.

As a result of the n^{th} data point, namely the values of N_n and r_n for the n^{th} year are given $(r_n = n)$, and the value of r_{n+1} for $(n+1)^{\text{th}}$ year is also known $(r_{n+1} = n+1)$, if the fractal dimension $D_{n,n+1}$ of the constant dimension fractal decided by the n^{th} data point and $(n+1)^{\text{th}}$ data point is known, then the value for the $(n+1)^{\text{th}}$ year can be solved from Eq.(2)

$$N_{n+1} = N_n \left(\frac{r_n}{r_{n+1}}\right)^{D_{n,n+1}} \qquad (5)$$

To this analogizes, the values for the $(n+2)^{\text{th}}$ year and the like can be solved.

As for how to decide the fractal dimension $D_{n,n+1}$, it needs the information given by D_{12} (decided by the given first data point and second data point), $D_{23} \cdots D_{n-1,n}$ (decided by other given data points). But in general case, it is very difficult to discover the changing rule for these values of fractal dimension.

In this case, the above method cannot be used directly. The transformation of accumulated sum for the given values have to be carried on firstly, then the above method can be used to forecast the values of accumulated sum for the $(n+1)^{\text{th}}$ year, $(n+2)^{\text{th}}$ year and so on. Finally the values to be predicted are solved by the values of accumulated sum.

The advantage for using accumulated sum is that a sequence with increasing and decreasing can be changed into a monotone increasing sequence.

This method may be introduced as follows.

The first step, plotting the original data points $(N_i, r_i)(i = 1 \sim n)$ in the double logarithmic coordinates. In the ordinary circumstances they cannot fairly agree with a constant dimension fractal model, $N_i\ (i = 1,2 \cdots n)$ may be arranged to a fundamental sequence, namely it can be written as

$$\{N_i\} = \{N_1, N_2, N_3 \cdots\} \quad (i = 1,2 \cdots n)$$

Other sequences may be constructed according to the fundamental sequence. For example, for $S^{(1)}$, i.e., the sequence of first order accumulated sum, $S_1^{(1)} = N_1$, $S_2^{(1)} = N_1 + N_2$, $S_3^{(1)} = N_1 + N_2 + N_3$, …; according to analogize, the sequence of second order accumulated sum, the sequence of third order accumulated sum, and the like can be constructed, namely it can be written as

$$\{S_i^{(1)}\} = \{N_1, N_1 + N_2, N_1 + N_2 + N_3, \cdots\} \quad (i = 1,2 \cdots n) \qquad (6)$$

$$\{S_i^{(2)}\} = \{S_1^{(1)}, S_1^{(1)} + S_2^{(1)}, S_1^{(1)} + S_2^{(1)} + S_3^{(1)} \cdots\} \quad (i = 1,2 \cdots n) \qquad (7)$$

$$\{S_i^{(3)}\} = \{S_1^{(2)}, S_1^{(2)} + S_2^{(2)}, S_1^{(2)} + S_2^{(2)} + S_3^{(2)} \cdots\} \quad (i = 1,2 \cdots n)$$

$$\{S_i^{(4)}\} = \{S_1^{(3)}, S_1^{(3)} + S_2^{(3)}, S_1^{(3)} + S_2^{(3)} + S_3^{(3)} \cdots\} \quad (i = 1,2 \cdots n)$$

It needs to point out that $S_i^{(2)}$ denote second order accumulated sum, instead of the second power of S_i. $S_i^{(3)}$ and the like should be comprehended similarly.

The second step, establishing the fractal models for various order accumulated sum. Taking the second order accumulated sum as an example. Plotting the data points $(S_i^{(2)}, r_i)(i = 1 \sim n)$ in the double logarithmic coordinates, linking these points one by one，it may result in the sectioned constant dimension fractal model. For example, according to n data points, the sectioned constant dimension fractal model composed from $n-1$ straight lines (for different straight line, its fractal dimension is also different, this also is the simplest variable dimension fractal model), and the fractal parameters $D_{ij}^{(2)},(i=1\sim n-1, j=i+1)$ and $C_{ij}^{(2)}$ for each straight line can be calculated according to Eq.(2) and Eq. (3) (in which the value of N_i is replaced by $S_i^{(2)}$) Which means

$$D_{ij}^{(2)} = \ln(S_i^{(2)}/S_j^{(2)})/\ln(r_j/r_i) \qquad (8)$$

$$C_{ij}^{(2)} = S_i^{(2)} r_i^{D_{ij}^{(2)}} \qquad (9)$$

The third step, choosing the best transformation and determining its corresponding fractal parameters. Separately drawing various order accumulated sum's data points in the double logarithmic coordinates, then choosing the best transformation (its values of fractal dimension are even increased or even decreased) and determining its corresponding fractal parameters. Because in the ordinary circumstances, the second order accumulated sum is the best, the case of second order accumulated sum will be discussed only.

After choosing the fractal model, the suitable method should be used for deciding the fractal dimension $D_{n,n+1}^{(2)}$ firstly, then uses the reconstructive Eq.(5) to carry on the forecast for accumulated sum. Because the values of fractal dimension are evenly increased or evenly decreased, using the following linear interpolation formula can solve the fractal dimension $D_{n,n+1}^{(2)}$

$$D_{n,n+1}^{(2)} = 2D_{n-1,n}^{(2)} - D_{n-2,n-1}^{(2)} \qquad (10)$$

For the second order accumulated sum, Eq.(5) can be expressed by

$$S_{n+1}^{(2)} = S_n^{(2)}\left(\frac{r_n}{r_{n+1}}\right)^{D_{n,n+1}^{(2)}} \qquad (11)$$

For the reason that $S_1^{(1)} \sim S_n^{(1)}$, $S_1^{(2)} \sim S_n^{(2)}$ are already calculated, then the forecasting first order accumulated sum can be obtained from the forecasted second order accumulated sum, which means

$$S_{n+1}^{(1)} = S_{n+1}^{(2)} - S_n^{(2)} \qquad (12)$$

Then the forecasting value can be obtained from the forecasted first order accumulated sum, which means

$$N_{n+1} = S_{n+1}^{(1)} - S_n^{(1)} \qquad (13)$$

According to analogize similarly, N_{n+2}, N_{n+3} and so on can be obtained.

It should be noted that, for some special questions, some necessary adjustments to the above-mentioned general fractal methods are needed to carry on. For example, some transformation processing should be made to the given data in advance.

Now some prediction and calculation examples are presented.

1) Until 08 o'clock, July 20, 1980, the tracks of No. 8007 typhoon (JOE) are given in Table 1, try to predict its future tracks [5].

Table 1 The given tracks of No. 8007 typhoon

No	Time/m–d –h			North latitude/(°)	East longitude /(°)
1	7	16	14	10.0	147.0
2			20	11.0	146.0
3		17	02	12.0	145.0
4			08	12.7	143.8
5			14	12.3	143.2
6			20	12.5	142.0
7		18	02	13.1	140.2
8			08	13.5	138.9
9			14	14.0	137.5
10			20	14.2	136.2
11		19	02	14.3	134.7
12			08	14.7	133.1
13			14	15.0	131.7
14			20	15.2	130.1
15		20	02	15.7	128.1
16			08	16.1	126.7

With the above-mentioned fractal prediction method, the future latitudes and longitudes may be obtained respectively.

All the prediction results of this paper, the real vales and the prediction results [6] are shown in Table 2 and Table 3.

Table 2 Prediction result for the latitudes of No. 8007 typhoon

No.	Time /m –d –h			Real value	Prediction value of this paper	Prediction value of Ref. [6]
17	7	20	14	16.3	16.4	
18			20	16.4	16.7	17.0
19		21	02	17.1	17.1	
20			08	17.4	17.4	18.2
21			14	18.1	17.8	
22			20	18.7	18.1	19.2
23		22	02	19.1	18.5	
24			08	19.5	18.8	20.0
25			14	20.1	19.2	
26			20	20.2	19.5	
27		23	02	20.4	19.9	
28			08	20.9	20.3	
29			14	20.9	20.6	
30			20	20.5	21.0	

Table 3 Prediction result for the longitudes of No. 8007 typhoon

No	Time /m –d –h	Real value	Prediction value of this paper	Prediction value of Ref. [6]

17	7	20	14	125.3	125.3	
18			20	123.8	123.8	123.6
19		21	02	122.1	122.4	
20			08	120.8	121.0	120.9
21			14	119.0	119.6	
22			20	117.2	118.2	118.4
23		22	02	115.3	116.8	
24			08	113.6	115.5	116.0
25			14	112.2	114.1	
26			20	110.3	112.8	
27		23	02	108.4	111.4	
28			08	106.7	110.1	
29			14	105.3	108.9	
30			20	103.0	107.5	

From the results of Table 2 and Table 3, it is known that although the result of longitudes is not so good, generally speaking the prediction results of this paper are satisfying.

2 Simplifying n-dimensional problem into only one problem of one dimension

The result of only one problem of one dimension will simplify a complicated question into a simple one.

For example, the stock index is effected by various factors, however as forecasting stock index we may assume that it is only a function of time.

Now we predict the stock index with variable dimension fractal method.

From November 1, 2000 to February 7, 2001, the program "Daily Finance and Economics" of Beijing wired television station conducted the competition of stock index prediction. Before 13 o'clock of every business day, the participants were requested to deliver their predictions for the closing index of the same day to the television station by telephone, 2 winners of the first prize (one for Shanghai market, another for Shenzhen market), 8 winners of the second prize and 10 winners of the third prize were awarded every day. We obtained the news on November 17 and began to participate. Until the competition end on February 7, 2001, we won the first prize twice (one for Shanghai market, another for Shenzhen market), the second prize twice and the third prize seven times.

The prediction results of the stock index of Shanghai market are as follows.

Table 4 Prediction results of the stock index of Shanghai market（1A0001）

No.	Date	Prediction Value	Real value	Error	Award
1	Nov. 16, 2000	2087.87	2095.98	-8.11	
2	Nov. 17, 2000	2104.99	2093.23	11.76	
3	Nov. 20, 2000	2103.48	2101.38	2.10	Third prize
4	Nov. 21, 2000	2115.14	2097.98	17.16	
5	Nov. 22, 2000	2109.29	2113.30	-4.01	
6	Nov. 23, 2000	2125.61	2119.43	6.18	
7	Nov. 24, 2000	2131.43	2053.37	78.06	
8	Nov. 27, 2000	2048.50	2049.67	-1.17	Third prize
9	Nov. 28, 2000	2071.23	2079.39	-8.16	
10	Nov. 29, 2000	2082.63	2067.49	15.14	
11	Nov. 30, 2000	2063.54	2070.61	-7.07	
12	Dec. 1, 2000	2082.96	2081.84	1.12	
13	Dec. 4, 2000	2092.32	2092.13	0.19	Second prize
14	Dec. 5, 2000	2099.49	2091.66	7.83	
15	Dec. 6, 2000	2095.93	2075.62	20.31	

16	Dec. 7, 2000	2065.51	2075.04	-9.53	
17	Dec. 8, 2000	2085.09	2073.16	11.93	
18	Dec. 11, 2000	2044.21	2046.07	-1.86	Third prize
19	Dec. 12, 2000	2047.74	2059.05	-11.31	
20	Dec. 13, 2000	2057.62	2056.12	1.50	
21	Dec. 14, 2000	2055.93	2051.07	4.86	
22	Dec. 15, 2000	2041.31	2039.36	1.95	
23	Dec. 18, 2000	2026.44	2044.54	-18.10	
24	Dec. 19, 2000	2052.43	2049.03	3.40	
25	Dec. 20, 2000	2058.43	2071.26	-12.83	
26	Dec. 21, 2000	2084.98	2076.89	8.09	
27	Dec. 22, 2000	2079.10	2069.77	9.33	
28	Dec. 25, 2000	2071.63	2068.17	3.46	
29	Dec. 26, 2000	2075.03	2076.26	-1.23	
30	Dec. 27, 2000	2070.66	2058.24	12.42	
31	Dec. 28, 2000	2057.65	2053.70	3.95	
32	Dec. 29, 2000	2070.41	2073.47	-3.06	
33	Jan. 2, 2001	2095.00	2103.46	-8.46	
34	Jan. 3, 2001	2121.09	2123.89	-2.80	
35	Jan. 4, 2001	2123.90	2117.40	6.50	
36	Jan. 5, 2001	2125.34	2125.30	0.04	First prize
37	Jan. 8, 2001	2108.06	2102.06	6.00	
38	Jan. 9, 2001	2098.75	2101.13	-2.38	
39	Jan. 10, 2001	2120.91	2125.61	-4.70	
40	Jan. 11, 2001	2132.74	2119.14	13.60	
41	Jan. 12, 2001	2106.41	2104.74	1.67	
42	Jan. 15, 2001	2054.82	2032.44	22.38	
43	Jan. 16, 2001	2003.01	2006.88	-3.87	
44	Jan. 17, 2001	2035.48	2034.58	0.90	
45	Jan. 18, 2001	2043.70	2043.10	0.60	Third prize
46	Jan. 19, 2001	2063.47	2065.60	-2.13	
47	Feb. 5, 2001	2036.62	2008.03	28.59	
48	Feb. 6, 2001	1960.85	1995.31	-34.46	
49	Feb. 7, 2001	1979.34	1979.93	-0.59	Second prize

In the above continual 49 days' actual predictions, there were 2 days that the error less than 0.5, 5 days the error less than 1.0, 12 days the error less than 2.0, 24 days the error less than 5.0, 35 days the error less than 10.0, and 14 days the error greater than 10.0.

Obviously, this method also may be used to predict the stock price.

3 Finding the solution suitable for one point only with single point method

In order to improve the effect of one dimensional method, we can change finding the solution suitable for whole space or a domain, into finding the solution suitable for one point only with single point method.

In the existing methods for solving ordinary differential equations, there are already the examples for seeking the solution (point solution) suitable for one solitary point.

For example, consider the following differential equation

$$y' = y \,, \quad y(0) = 1$$

It gives

$$y'(0) = y''(0) = y'''(0) = y^{(n)}(0) = 1$$

According to the power series formula for $x = x_0$

$$y = y(x_0) + y'(x_0)x/1! + y''(x_0)x^2/2! + \cdots$$

It gives the “point solution” for $x_0 = 0$ as follows

$$y = 1 + x/1! + x^2/2! + \cdots$$

However, this “point solution” is applicable to the "whole domain", while in this paper we will consider the “point solution” suitable for one solitary point only.

For example, the single point method can be used to find the “point solution” of hydraulic problem that is suitable for one solitary point only. This kind of “point solution” is finding independently, namely the effect of other points may not be considered. As finding “point solution” for a certain point, the point collocation method should be used; that means that the “point solution” will satisfy the boundary condition on some selected boundary points; and on this certain point satisfy the hydraulic equation and the derived equations that are formed by running the derivitive operations to the hydraulic equation. Finally all the undetermined constants for the “point solution” will be determined by solving the equations that are formed by above mentioned point collocation method.

In reference [4], the single point method was used to determine the “point solution” on a certain solitary point for the problem of potential flow around a cylinder between two parallel plates.

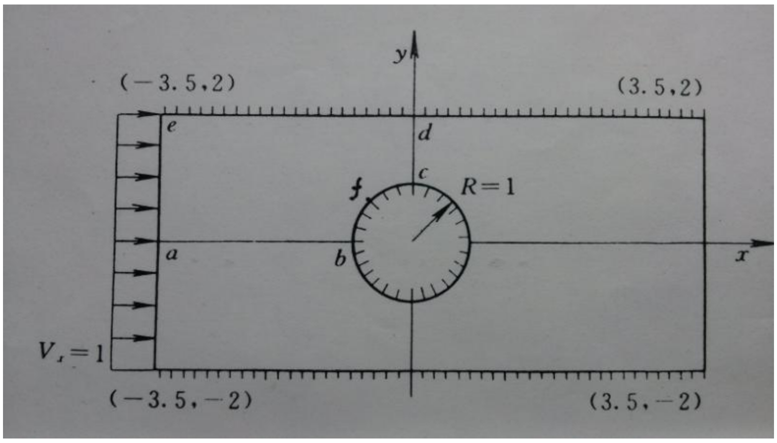

Fig. 1. Potential flow around a cylinder between two parallel plates

As shown in Figure 1, due to symmetry, one-fourth flow field can be considered only in the second quadrant.

The differential equation is as follows

$$F = \partial^2\varphi/\partial x^2 + \partial^2\varphi/\partial y^2 = 0 \qquad (14)$$

On boundary ab

$$\varphi = 0, \quad v_y = 0$$

On cylinder boundary bc

$$\varphi = 0\,,\quad v_r = 0$$

On boundary cd

$$v_y = 0$$

On plate boundary ed

$$\varphi = 2\,,\quad v_y = 0$$

On entrance boundary ae

$$\varphi = y\,,\quad v_x = 1$$

Taking “point solution” as the following form containing n undetermined constants

$$\varphi = y + y(x^2 - 12.25)(y^2 - 4)(K_1 + K_2 x^2 + K_3 y^2 + K_4 x^4 + K_5 y^4 + K_6 x^2 y^2 + \cdots + K_n x^p y^q) \quad (15)$$

Other 4 boundary equations are as follows

On point b

$$v_r(-1, 0) = 0 \quad (16)$$

On point c

$$\varphi(0, 1) = 0 \quad (17)$$

On point f

$$\varphi(-0.7071, 0.7071) = 0 \quad (18)$$

$$v_r(-0.7071, 0.7071) = 0 \quad (19)$$

For a certain solitary point (x_0, y_0), as $n = 6$, only 2 boundary equations Eq.(16) and Eq.(17) are considered; and the following 4 single point equations are considered.

The first single point equation is reached by Eq.(14)

$$F(x_0, y_0) = 0 \quad (20)$$

Other 3 single point equations are reached as follows by running the derivitive operations to Eq.(14).

$$\partial F(x_0, y_0)/\partial x = 0 \quad (21)$$

$$\partial F(x_0, y_0)/\partial y = 0 \quad (22)$$

$$\partial^2 F(x_0, y_0)/\partial x \partial y = 0 \quad (23)$$

Substituting the coordinates values (x_0, y_0) into Eq.(16) and Eq.(17), and Eq.(20) to

Eq.(23); after solving these 6 equations, the 6 undetermined constants K_1 to K_6 can be determined, namely the "point solution" for $n=6$ is reached.

As $n>8$, the 4 boundary equations Eq.(16) to Eq.(19) are considered; and besides the 4 single point equations Eq.(20) to Eq.(23), the following single point equations derived by running the derivitive operations to Eq.(14) are also considered.

$$\partial^2 F(x_0, y_0)/\partial x^2 = 0 \quad (24)$$

$$\partial^2 F(x_0, y_0)/\partial y^2 = 0 \quad (25)$$

$$\partial^3 F(x_0, y_0)/\partial x^3 = 0 \quad (26)$$

$$\partial^3 F(x_0, y_0)/\partial x^2 \partial y = 0 \quad (27)$$

$$\partial^3 F(x_0, y_0)/\partial x \partial y^2 = 0 \quad (28)$$

$$\partial^3 F(x_0, y_0)/\partial y^3 = 0 \quad (29)$$

……

Substituting the coordinates values (x_0, y_0) into Eq.(16) to Eq.(19), as well as Eq.(20) to Eq.(24), and the like; after solving these n equations, the n undetermined constants K_1 to K_n can be determined, namely the "point solution" as the form of Eq.(15) is reached.

For 8 solitary points, the comparisons between accurate analytical solution (AS) and point solution (PS) for the values of φ are shown in table 5.

Table 5. Comparisons between accurate analytical solution (AS) and point solution (PS) for the values of φ

No.	x_0	y_0	AS	$n=6$ PS	$n=10$ PS	$n=14$ PS	$n=19$ PS
1	-3.4	1.75	1.747	1.744	1.743	1.746	1.746
2	-3	1.75	1.744	1.729	1.735	1.736	1.738
3	-2.5	1.75	1.736	1.694	1.751	1.713	1.732
4	-2	1.75	1.721	1.609	1.782	1.631	1.766
5	-3.4	1.5	1.494	1.489	1.483	1.492	1.493
6	-3	1.5	1.488	1.459	1.452	1.473	1.474
7	-2.5	1.5	1.474	1.397	1.450	1.439	1.460
8	-2	1.5	1.445	1.248	1.518	1.272	1.563

For more information about single point method, see references [7-9].

The single point method can also be used for prediction.

For example, the sea surface temperature distribution of a given region, is a special two-dimensional problem influenced by many factors, and it is very difficult to be changed into 2 one-dimensional problems. However, this problem can be predicted for a certain solitary point by single point method.

The following example is predicting the monthly average sea surface temperature.

Based on sectional variable dimension fractals, the concept of weighted fractals is presented, i.e., for the data points in an interval, their r coordinates multiply by different weighted coefficients, and making these data points locate at a straight-line in the double logarithmic coordinates. By using weighted fractals, the monthly average sea surface temperature (MASST) data on the point 30 ℕ, 125 ℇ of Northwest Pacific Ocean are analyzed. According to the MASST from January to August in a certain year (eight-point-method), the MASST from September to December of that year has been predicted. Also, according to the MASST of August merely in a certain year (one-point-method), the MASST from September to December of that year has been predicted.

The MASST prediction results are as follows.

Table 6. MASST prediction results (unit: ℃) by using eight-point-method (8PM) and one-point-method(1PM)

Year	Notes	September	October	November	December
1958	8PM	28.21	25.51	22.67	20.17
	1PM	28.24	25.55	22.72	20.22
	Real value	27.7	25.5	21.2	20
1959	8PM	28.20	25.56	22.75	20.28
	1PM	28.19	25.54	22.73	20.26
	Real value	27.6	24.7	22.9	20
1960	8PM	27.95	25.36	22.60	20.16
	1PM	28.05	25.51	22.78	20.36
	Real value	28	26	21.8	20
1961	8PM	28.70	26.14	23.37	20.91
	1PM	28.34	25.57	22.69	20.16
	Real value	28.4	26.2	22.8	22
1962	8PM	28.30	26.00	23.46	21.17
	1PM	27.90	25.48	22.83	20.47
	Real value	28	25	21	20
1963	8PM	29.36	27.86	25.78	23.80
	1PM	27.86	25.47	22.85	20.50
	Real value	27.5	24.5	21	18
1964	8PM	28.04	25.83	23.32	21.05
	1PM	27.80	25.46	22.86	20.54
	Real value	28	24.5	22	19

In addition, according to the phenomenon of fractal interrelation and the fractal coefficients of this point's MASST and the monthly average air temperature of August of some points, the monthly average air temperatures of these points from September to December have also been predicted. For detailed information, see reference [10].

4 Further topics

For fractal method, in addition to the above mentioned methods, other methods include complex fractal mrthod, fractal series method (for example, the fractal series presented in reference [12] as follows: N = $\sum \frac{C_i}{r^{D_i}} = \frac{C_1}{r^{D_1}} + \frac{C_2}{r^{D_2}} + \ldots\ldots$), and the like. For more information, see references [12].

Based on references [12] and this paper, the further topics include: more applications of fractal method in one dimensional method for Clifford analysisin; the relationship between the results of one dimensional method for Clifford analysisin and the results of the usual Clifford analysis, and the like.

5 Conclusions

This paper discusses the application of one-dimension method in Clifford analysis. Examples show that one-dimensional method is simple and effective, so one-dimension method in Clifford analysis will have broad and good prospects.

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