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WEATHER TEMPERATURE COMPUTATION USING DISCRETE FOURIER TRANSFORMATION TOOLS

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Abstract-*The weather temperature computation procedure has been discussed. This paper presents an application of Discrete Fourier Transformation (DFT) technique for weather temperature computation. This temperature computation is based on the previous daily maximum temperature. The experimental result of the temperature computed can found to be in good agreement with the data obtained from Bangladesh Meteorological Department.*

***Key words*: Temperature, DFT, Fourier, Weather**

INTRODUCTION

Weather temperature computation is a complex process and a challenging task for researchers. It includes expertise in multiple disciplines [1], [2]. Weather generally refers to day-to-day temperature and precipitation activity, whereas climate is the term for the average atmospheric conditions over longer periods of time. Weather temperature computation is essential for now a day. This weather temperature computation is helpful in agriculture and production, planning in energy industry, aviation industry, communication, pollution dispersal [3] etc. We are not knows everything till tomorrow, there is always a hope for the future of what happens to be unpredictable. Some scholars believe that forecast of the matters mentioned is generally believed to be a very difficult task. They were using some forecasting techniques to forecast temperature, stock market etc. The scholars[1-8] tomorrow's temperature [9-15] enrollments of the next year [16] proposed the fuzzy set theory first and then got fruitful achievements both in theory and applications. *In Li et al. (1988)* proposed a method for the weather forecast considering fuzziness between the demarcation lines of fuzzy grades and the membership functions of fuzzy grade. Song and Chissom introduced a new forecast model based on the concept of fuzzy time series [17]. This paper contributes for introducing a technique DFT. This technique calculates the maximum weather temperature in the region of Bangladesh.

DISCRETE FOURER TRANSFORMATION

In mathematics, the discrete Fourier transform (DFT) is a specific kind of Fourier transformation, used in Fourier analysis. The DFT requires an input function that is discrete and whose non-zero values have a limited (finite) duration [18] such inputs are often created by sampling a continuous function, like a person's voice. And unlike the Discrete Time Fourier Transformation (DTFT), it only evaluates enough frequency components to reconstruct the finite segment that was analyzed. Its inverse transform cannot reproduce the entire time domain, unless the input happens to be periodic. Therefore, it is often said that the DFT is a transform for Fourier analysis of finite-domain discrete-time functions. The sinusoidal basis functions of the decomposition have the same properties. Since the input function is a finite sequence of real or complex number, the DFT is ideal for processing information stored in computers. In particular, the DFT is widely employed in signal processing and related fields to analyze the frequencies containing in a sampled signal, to solve partial differential equation, and to perform other operations such as convolution.

I. THE METHOD

Consider,

$$y_n = \frac{1}{2}A_0 + \sum_{p=1}^{N/2}\left[A_p \cos\left(\frac{2\pi pn}{N}\right) + B_p \sin\left(\frac{2\pi pn}{N}\right)\right], \quad n = 0,........N-1.$$

sum over n, yields

$$\sum_{n=0}^{N-1} y_n = \sum_{n=0}^{N-1}\left\{\frac{1}{2}A_0 + \sum_{p=1}^{N/2}\left[A_p \cos\left(\frac{2\pi pn}{N}\right) + B_p \sin\left(\frac{2\pi pn}{N}\right)\right]\right\}$$

$$= \frac{1}{2}A_0\sum_{n=0}^{N-1}1 + \sum_{p=1}^{N/2}\left\{A_p \sum\cos\left(\frac{2\pi pn}{N}\right) + B_p \sum_{n=0}^{N-1}\sin\left(\frac{2\pi pn}{N}\right)\right\}$$

$$= \frac{1}{2}A_0 N + \sum_{p=1}^{N/2}\left(A_p.0 + B_p.0\right)$$

$$= \frac{1}{2}A_0 N.$$

(1.1)

Therefore, we have

$$A_0 = \frac{2}{N}\sum_{n=0}^{N-1} y(t_n).$$

(1.2)

Now, we multiply both sides by $\cos\left(\frac{2\pi qn}{N}\right)$ and sum over n. Then

$$\sum_{n=0}^{N-1} y_n \cos\left(\frac{2\pi qn}{N}\right) = \sum_{n=0}^{N-1}\left\{\frac{1}{2}A_0 + \sum_{p=1}^{N/2}\left[A_p \cos\left(\frac{2\pi pn}{N}\right) + B_p \sin\left(\frac{2\pi pn}{N}\right)\right]\right\}\cos\left(\frac{2\pi qn}{N}\right)$$

$$= \frac{1}{2}A_0\sum_{n=0}^{N-1}\cos\left(\frac{2\pi qn}{N}\right) + \sum_{p=1}^{N/2}\left\{A_p\sum_{n=0}^{N-1}\cos\left(\frac{2\pi qn}{N}\right) + B_p\sum_{n=0}^{N-1}\sin\left(\frac{2\pi pn}{N}\right)\cos\left(\frac{2\pi qn}{N}\right)\right\}$$

$$= \begin{cases} \sum_{p=1}^{N/2}\left\{A_p \frac{N}{2}\delta_{p,q} + B_p.0\right\} & q \neq N/2 \\ \sum_{p=1}^{N/2}\left\{A_p N\delta_{p,N/2} + B_p.0\right\} & q = N/2 \end{cases}$$

$$= \begin{cases} \frac{1}{2}A_q N & q \neq N/2 \\ A_{N/2} N & q = N/2 \end{cases}.$$

Thus we found that

$$A_q = \frac{2}{N}\sum_{n=0}^{N-1} y(t_n)\cos\left(\frac{2\pi qn}{N}\right), \quad q \neq N/2$$

(1.3)

$$A_{N/2} = \frac{1}{N}\sum_{n=0}^{N-1} y(t_n)\cos\left(\frac{2\pi n(N/2)}{N}\right) = \frac{1}{N}\sum_{n=0}^{N-1} y(t_n)\cos(\pi n) \qquad (1.4)$$

Similarly, $\sum_{n=0}^{N-1} y_n \sin\left(\frac{2\pi qn}{N}\right)$

$$= \sum_{n=0}^{N-1}\left\{\frac{1}{2}A_0 + \sum_{p=1}^{N/2}\left[A_p \cos\left(\frac{2\pi pn}{N}\right) + B_p \sin\left(\frac{2\pi pn}{N}\right)\right]\right\}\sin\left(\frac{2\pi qn}{N}\right)$$

$$= \frac{1}{2}A_0\sum_{n=0}^{N-1}\sin\left(\frac{2\pi qn}{N}\right) + \sum_{p=1}^{N/2}\left\{A_p\sum_{n=0}^{N-1}\cos\left(\frac{2\pi pn}{N}\right)\sin\left(\frac{2\pi qn}{N}\right) + B_p\sum_{n=0}^{N-1}\sin\left(\frac{2\pi pn}{N}\right)\sin\left(\frac{2\pi qn}{N}\right)\right\}$$

$$= \sum_{p=1}^{N/2}\left\{A_p.0 + B_p \frac{N}{2}\delta_{p,q}\right\}$$

$$= \frac{1}{2}B_q N.$$

(1.5)

Finally, we get

$$B_q = \frac{2}{N}\sum_{n=0}^{N-1} y(t_n)\sin\left(\frac{2\pi qn}{N}\right),$$

(1.6)

$$q = 1,\ldots\ldots\ldots\ldots\ldots\frac{N}{2}-1.$$

We have

$$y_n = \frac{1}{2}A_0 + \sum_{p=1}^{N/2}\left[A_p\cos\left(\frac{2\pi pn}{N}\right) + B_p\sin\left(\frac{2\pi pn}{N}\right)\right], \quad n = 0,\ldots\ldots N-1$$

Or

$$y_n = \frac{1}{2}A_0 + \sum_{p=1}^{M}[A_p\cos(\omega_p t_n) + B_p\sin(\omega_p t_n)], \quad n = 0,\ 1,\ 2,\ldots N-1.$$

Where $\omega_p t_n = \frac{2\pi pn}{N}$

Suppose, to take a simple example that the temperature curve from weather station was exactly

$$y(t) = \frac{1}{2}A_0 + A_1\cos(\omega_1 t) + B\ \sin(\omega_1) + A_2 2\cos(\omega_2 t) + B_2\sin(\omega_2 t) \quad (1.7)$$

To predict approximate temperature, we need to calculate the coefficients A_0, A_1, A_2, B_0, B_1, B_2. These can be done easily by using equations (1.2), (1.3), (1.6), and (1.7) .

II. RESULT AND DISCUSSION

The present study has been focusing the weather temperature calculation. Our computed results are presented the weather temperature of the month January, February, and March 2011 at Dhaka region of Bangladesh, as shown in Fig.1.1. Fig.1.2, Fig.1.3.. Also the first six month weather temperature is shown in Fig.1.4.

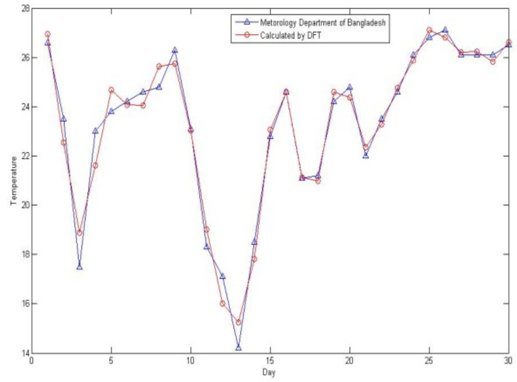

Fig.1.1. Computed temperature of the month January 2011 is compared.

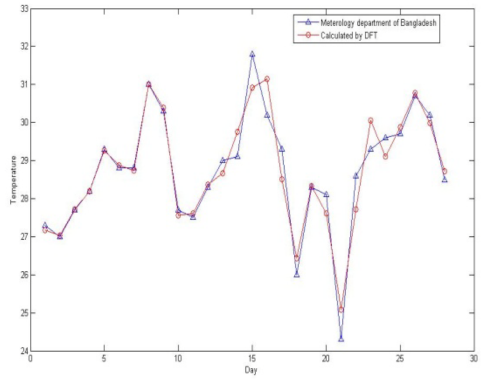

Fig.1.2. Computed temperature of the month February 2011 is compared.

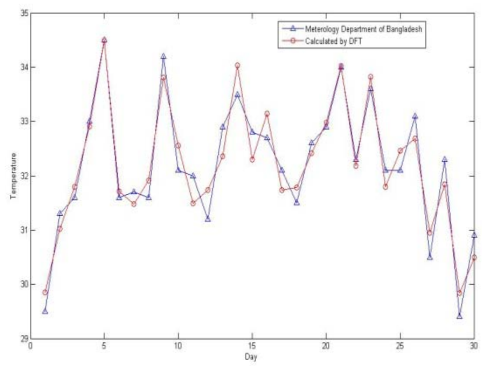

Fig.1.3. Computed temperature of the month March2011 is compared.

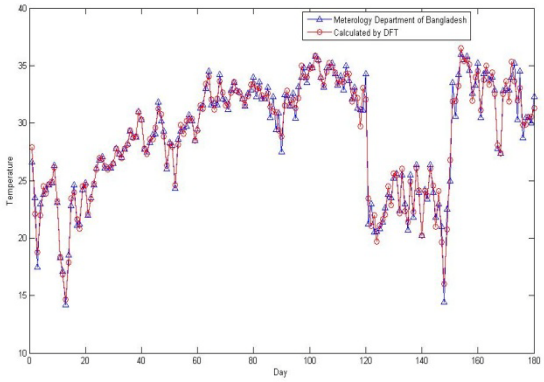

Fig.1.4. Computed temperature of the month January to July 2011 is compared.

We may hope that the DFT technique is an acceptable tool like other existing tools for calculate or predict weather temperature.

CONCLUTION

We have computed approximately the weather temperature at Dhaka region in Bangladesh, using DFT. The results are found to be in good agreement with the weather temperature data from the Meteorology Department of Bangladesh. By this work we can calculate temperature over all positions in Bangladesh. We think our work could be helpful to calculate weather temperature as like as the existing method.

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