INTERPOLATION METHOD FOR MISSING DATA OF MEASUREMENT IN MEGA SOLAR POWER PLANT USING WAVELET TRANSFORMS

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Measurement in mega solar power plants (MSPPs) can contain missing data due to the wideness of its area. Since measured data containing missing values are difficult to be used by diagnostic systems of mega solar power plant, the interpolation of the data missing intervals is desirable. Measurement data in MSPP, such as string power, often have fast oscillation like Figure 1 (a). Conventional interpolation methods, such as polynomial interpolation methods, make an interpolation which connect the data missing interval as smooth as possible (Figure 1 (b)). However the desirable interpolation for the oscillating measurement data is an oscillating interpolation like Figure 1 (c).

We proposed a new interpolation method using the discrete Fourier transform (DFT) [1]. The method uses the information about the degree of oscillation in the both neighboring intervals before and after the data missing interval. If the measurement day has a change of oscillation, such as cloudy after clear day, we need to pay special attention for deciding the width of the both neighboring intervals. In this research we propose an interpolation method using wavelet transforms, which has a capability to overcome that difficulty. In Figure 2 we show four wavelet vectors of level 1 for discrete time series whose length is 8. Wavelet transforms can express both oscillation and points of time. Using this feature of wavelet transforms we can construct an interpolation method which uses oscillation information at near points of time.

Figure 3 shows a result of the wavelet interpolation. The curve is string powers measured at Yoshinogari mega solar power plant in Japan for one day, whose measurement interval is ten minutes. We virtually consider six time points from 2 p.m. before 3 p.m. as missing points, and have applied the wavelet interpolation method to the interval. The figure shows that it can produce an interpolation whose oscillation has the same frequency as neighboring intervals. Table 1 shows mean absolute errors (MAEs) of four interpolation methods for our test data set. Akima spline interpolation method is a conventional method. ‘DFT’ and ‘irradiance DFT’ are our interpolation methods proposed in [1]. The MAE of the wavelet interpolation method is not good as the irradiance DFT method, but we shall construct new interpolation method whose MAE for the test data set is still lower by using the irradiance DFT method and the wavelet method together.

![Figure 1. Data missing interval and its interpolation. (a) Measurement data with data missing interval, (b) Interpolation by conventional interpolation method, (c) Desirable interpolation.](image1)

![Figure 2. Level one wavelet vectors](image2)

![Figure 3. A result of wavelet interpolation](image3)

| Table 1. Mean absolute errors of four interpolation methods for the test data set |
|-----------------|--------------|----------------|----------------|
|                 | Akima spline | DFT            | Irradiance DFT |
| Mean Absolute Error | 22.0%        | 16.6%          | 12.6%          | 17.8%          |

Reference