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Comparison of Power Generation Status of Photovoltaic Systems under Different Weather Conditions

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Abstract : Based on multivariate statistical analysis theory, this paper uses the principal component analysis method, Mahalanobis distance analysis method and fitting method to establish the photovoltaic health model to evaluate the health of photovoltaic panels. First of all, according to weather conditions, the photovoltaic panel variable data are classified into five categories: sunny, cloudy, rainy, foggy, overcast. The health of photovoltaic panels in these five types of weather is studied. Secondly, a scatterplot of the relationship between the amount of electricity produced by each kind of weather and other variables was plotted. It was found that the amount of electricity generated by photovoltaic panels has a significant nonlinear relationship with time. The fitting method was used to fit the relationship between the amount of weather generated and the time, and the nonlinear equation was obtained. Then, using the principal component analysis method to analyze the independent variables under five kinds of weather conditions, according to the Kaiser-Meyer-Olkin test, it was found that three types of weather such as overcast, foggy, and sunny meet the conditions for factor analysis, while cloudy and rainy weather do not satisfy the conditions for factor analysis. Therefore, through the principal component analysis method, the main components of overcast weather are temperature, AQI, and pm2.5. The main component of foggy weather is temperature, and the main components of sunny weather are temperature, AQI, and pm2.5. Cloudy and rainy weather require analysis of all of their variables, namely temperature, AQI, pm2.5, solar radiation intensity and time. Finally, taking the variable values in sunny weather as observed values, taking the main components of cloudy, foggy, overcast and rainy weather as sample data, the Mahalanobis distances between observed value and these sample values are obtained. A comparative analysis was carried out to compare the degree of deviation of the Mahalanobis distance to determine the health of the photovoltaic panels under different weather conditions. It was found that the weather conditions in which the Mahalanobis distance fluctuations ranged from small to large were: foggy, cloudy, overcast and rainy.

Keywords : fitting, principal component analysis, Mahalanobis distance, SPSS, MATLAB
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