

CLAIMS

What is claimed is:

- 5 1. A computer-implemented method for chiller performance anomaly diagnosis, the method comprising:
 - setting a first correlation model between a performance parameter of a chiller and a first plurality of operational parameters;
 - 10 determining an ~~optimal~~ window size for performing a root cause analysis diagnosis based on the first correlation model with respect to an anomaly identified in the performance parameter; and
 - performing the root cause analysis diagnosis based on the first correlation model and the ~~optimal~~ determined window size with respect to the anomaly for determining a root cause of the anomaly identified in the performance parameter of the chiller, the root cause analysis diagnosis being performed on a dataset comprising measurement data relating to the performance parameter and the first plurality of operational parameters collected over a period of time, including anomaly measurement data having an anomaly period associated with the anomaly.
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2. The method according to claim 1, wherein said determining an ~~optimal~~ window size comprises:
 - obtaining a plurality of candidate window sizes; and
 - assessing each of the plurality of candidate window sizes with respect to
 - 25 the first correlation model for determining a ~~candidate~~ the window size amongst the plurality of candidate window sizes ~~that is optimal~~ for performing the root cause analysis diagnosis based on the first correlation model with respect to the anomaly.
- 30 3. The method according to claim 2, wherein said assessing each of the plurality of candidate window sizes comprises, for each candidate window size:

generating a set of anomaly data samples from the dataset, each anomaly data sample generated based on the candidate window size and includes at least an anomaly data point belonging to the anomaly measurement data;

5 performing a multiple linear regression analysis on the set of anomaly data samples based on the first correlation model; and

determining an overall quality measure of fit of the first correlation model to the set of anomaly data samples generated.

10 4. The method according to claim 3, wherein the set of anomaly data samples is generated based on a sliding window technique performed across the anomaly period.

15 5. The method according to claim 4, wherein the sliding window technique comprises generating a first anomaly data sample comprising a starting data point of the anomaly measurement data and generating a subsequent anomaly data sample for each subsequent time interval until a last anomaly data sample comprising a last data point of the anomaly measurement data to generate the set of anomaly data samples.

20 6. The method according to claim 5, wherein the first anomaly data sample has an anomaly sample period ending at the starting data point of the anomaly measurement data, and the last anomaly data sample has an anomaly sample period starting at the last data point of the anomaly measurement data.

25 7. The method according to any one of claims 4 to 6, wherein each anomaly data sample of the set of anomaly data samples has an anomaly sample period length determined based on the candidate window size.

30 8. The method according to any one of claims 3 to 7, wherein said performing a multiple linear regression analysis comprises:

performing, for each anomaly data sample of the set of anomaly data samples, a multiple linear regression analysis on the anomaly data sample based on the first correlation model; and

determining, for each anomaly data sample of the set of anomaly data samples, a first quality measure of fit of the first correlation model to the anomaly data sample to generate a set of first quality measures for the set of anomaly data samples,

wherein the overall quality measure of fit of the first correlation model to the set of anomaly data samples is determined based on the set of first quality measures.

9. The method according to claim 8, wherein the first quality measure comprises a square of multiple correlation coefficients of the first correlation model to the anomaly data sample, and the overall quality measure comprises a confidence interval of the set of first quality measures determined.

10. The method according to any one of claims 3 to 9, wherein said assessing each of the plurality of candidate window sizes further comprises determining one of the plurality of candidate window sizes as the ~~optimal~~-window size based on the respective overall quality measures determined for the plurality of candidate window sizes.

11. The method according to any one of claims 1 to 10, further comprising:
determining whether the root cause determined from the root cause analysis diagnosis with respect to the anomaly based on the first correlation model and the ~~optimal-determined~~ window size is a synthesized operational parameter synthesized from a second plurality of operational parameters.

12. The method according to claim 11, further comprising:
determining the root cause to be a synthesized operational parameter;

setting a second correlation model between the performance parameter and the second plurality of operational parameters associated with the synthesized operational parameter;

determining a second ~~optimal~~-window size for performing a second root cause analysis diagnosis with respect to the anomaly based on the second correlation model; and

performing the second root cause analysis diagnosis based on the second correlation model and the determined second ~~optimal~~-window size with respect to the anomaly for determining a second root cause of the anomaly identified in the performance parameter of the chiller, the second root cause analysis diagnosis being performed on a second dataset comprising measurement data relating to the performance parameter and the second plurality of operational parameters collected over said period of time, including the anomaly measurement data.

13. The method according to claim 11 or 12, wherein:

the performance parameter is selected from a group consisting of chilled water supply, coefficient of performance, and chilled water supply temperature;

the operational parameters are selected from a group consisting of chilled water return temperature, chilled water flow rate, cooling water supply temperature, cooling water flow rate, steam flow rate, steam pressure, cooling water return temperature, electricity consumption, and ambient air temperature; and

the synthesized operational parameter is selected from a group consisting of chilled water return quality, cooling water supply quality, and steam supply quality.

14. A system for chiller performance anomaly diagnosis, the system comprising:

a memory; and

at least one processor communicatively coupled to the memory and configured to perform the method for chiller performance anomaly diagnosis according to any one of claims 1 to 13.

15. A computer program product, embodied in one or more non-transitory computer-readable storage mediums, comprising instructions executable by at least one processor to perform a method for chiller performance anomaly diagnosis according to any one of claims 1 to 13.
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