CLAIMS

1. A method for detecting a first fault condition of a plurality of fault conditions during processing of a first substrate, said method comprising:

collecting first data via sensors during said processing of said substrate, wherein said first data includes a first set of samples and a second set of samples;

sending said first data to a fault device;

processing said first data via said fault device including

determining a corrected fault vector including

determining a drift vector corresponding to drift in one or more parameters of a plasma processing chamber,

determining an uncorrected fault vector based on the first set of samples and the second set of samples, and

based on the drift vector, correcting the uncorrected fault vector to generate the corrected fault vector, and

comparing a first portion of said first data to a plurality of fault models stored within a fault library, wherein said plurality of fault models correspond respectively to said plurality of fault conditions, wherein said plurality of fault models include respective ones of (i) a plurality of fault vectors, (ii) a plurality of fault boundaries, and (iii) sets of principal component analysis (PCA) parameters, and wherein said plurality of fault vectors include said corrected fault vector; and

detecting said first fault condition based on said comparing of said first portion of said first data to said plurality of fault models.

2. The method of claim 1 wherein said processing of said first data by said fault device includes:

calculating summary statistic values for each channel of said sensors; andpre-filtering said first data to exclude a second portion of said first data from a first set of channels of said sensors, wherein said first set of channels are invariant to said plurality of fault conditions.

3. The method of claim 2, wherein:

said processing of said includes performing weighted PCA on said first portion of said first data from a second set of channels of said sensors; and

said first portion of said first data from said second set of channels does not include said second portion of said first data from said first set of channels.

4. The method of claim 3, wherein:

said processing of said first data includes generating a set of data samples, represented in a multi-dimensional PCA space, based on one of said sets of PCA parameters;

said drift vector is based on said set of samples as represented in said multi-dimensional PCA space; and

said drift of said plasma processing chamber is represented by said drift vector in said multi-dimensional PCA space.

5. The method of claim 4, wherein said comparing of said first portion of said first data to said plurality of faults models includes determining a correlation value for said data based on a fault vector of a first fault model of said plurality of fault models.

6. The method of claim 5, wherein:

said comparing of said first portion of said first data to said plurality of fault models includes determining if said first portion of said first data is within a fault boundary of said first fault model;

if said first portion of said first data is within said fault boundary of said first fault model, generating a warning signal indicating a possible fault condition; and

if said first portion of said first data is outside of said fault boundary of said first fault model, identifying a second fault model of said plurality of fault models and comparing said first portion of said first data to said second fault model.

7. The method of claim 1, wherein said each of said plurality of fault models is generated by:

collecting sets of data from said sensors respectively for a plurality of substrates, wherein said sets of data include said first data, and wherein said plurality of substrates include said first substrate;

assigning designations respectively to said sets of data, wherein each of said designations is identified as a bad set of data, a good set of data, or an unknown set of data; and

pre-filtering a plurality of channels of said sensors to exclude data from a first portion of said plurality of channels of said sensors, wherein said first portion of said plurality of channels does not contribute to fault detection, wherein said pre-filtering includes calculating, for each of said plurality of substrates, a summary of statistical values for a second portion of said plurality of channels.

8. The method of claim 7, wherein each of said designation is based on conditions of components with said plasma processing chamber and conditions of one of said plurality of substrates.

9. The method of claim 7, wherein said calculating of said summary of statistical values includes applying a local linear fit to said set of data.

10. The method of claim 7, wherein said pre-filtering further includes calculating a variation in said summary of statistical values.

11. arrangement system for detecting a first fault condition of a plurality of fault conditions during processing of a first substrate within a plasma processing chamber, the system comprising:

sensors configured for monitoring said plasma processing chamber during said processing of said first substrate;

a fault library configured to store a plurality of fault models, wherein each of said plurality of fault models correspond respectively to said plurality of fault conditions; and

a fault device configured to (i) collect first data from said sensors, wherein said first data includes a first set of samples and a second set of samples, and (ii) analyze a first portion of said first data including

determining a corrected fault vector including

determining a drift vector corresponding to drift in one or more parameters of said plasma processing chamber,

determining an uncorrected fault vector based on the first set of samples and the second set of samples, and

based on the drift vector, correcting the uncorrected fault vector to generate the corrected fault vector,

comparing said first portion of said first data to at least one of said plurality of fault models, wherein said plurality of fault models includes respective ones of (i) a plurality of fault vectors, (ii) a plurality of fault boundaries, and sets of principal component analysis (PCA) parameters, wherein said plurality of fault vectors include said corrected fault vector, and wherein said at least one of said plurality of fault models includes said corrected fault vector, and

detecting said first fault condition based on said comparing of said first portion of said first data to said at least one of said plurality of fault models.

12. The system of claim 11, further including a controller configured for to control said plasma processing system based on outputs of said fault device.

13. The system of claim 11, wherein said fault device is configured to:

calculate summary statistic values for each channel of said sensors; and

pre-filter said first data to exclude a second portion of said first data from a first set of channels of said sensors, wherein said first set of channels are invariant to said plurality of fault conditions.

14. The system of claim 13, wherein:

said fault device is configured to perform a weighted PCA on said first portion of said first data from a second set of channels of said sensors; and

said first portion of said first data from said second set of channels does not include said second portion of said first data from said first set of channels.

15. The system of claim 14, wherein:

said fault device is configured to generate a set of data samples, represented in a multi-dimensional PCA space, based on one of said sets of PCA parameters;

said drift vector is based on said set of samples as represented in said multi-dimensional PCA space; and

said drift of said plasma processing chamber is represented by said drift vector in said multi-dimensional PCA space.

16. The system of claim 15, wherein said fault device is configured to determine a correlation value for said first data based on a fault vector of a first fault model of said plurality of fault models.

17. The system of claim 16, wherein said fault device is configured to:

compare said first portion of said first data to said plurality of fault models;

determine if said first portion of said first data is within a fault boundary of said first fault model;

if said first portion of said first data is within said fault boundary of said first fault model, generate a warning signal indicating a possible fault condition, and

if said first portion of said first data is outside of said fault boundary of said first fault model, identify a second fault model of said plurality of fault models and compare said first portion of said first data to said second fault model.

18. The arrangement of claim 11, wherein said fault device is configured to generate each of said plurality of fault models by:

collecting sets of data from said sensors respectively for a plurality of substrates, wherein said sets of data include said first data, and wherein said plurality of substrates include said first substrate;

assigning designations respectively to said sest of data, wherein each of said designations is identified as a bad set of data, a good set of data, or an unknown set of data; and

pre-filtering a plurality of channels of said sensors to exclude data from a first portion of said plurality of channels of said sensors, wherein said first portion of said plurality of channels do not contribute to fault detection, wherein said pre-filtering includes calculating, for each of said plurality of substrates, a summary of statistical values for a second portion of said plurality of channels.

19. The system of claim 18, wherein each of said designations is based on condition of components with said plasma processing chamber and conditions of one of said plurality of substrates.

20. The system of claim 18, wherein said fault device is configured to while calculating said summary of statistical values, apply a local linear fit to said sets of data.

21. The method of claim 1, wherein said corrected fault vector is normal to said drift vector.

22. The method of claim 1, wherein:

said drift vector passes between two of said first set of samples, wherein said first set of samples are identified as good samples;

said uncorrected fault vector has a first initial point on said drift vector and extends between two of said second set of samples, wherein said second set of samples are identified as bad samples; and

said corrected fault vector has a second initial point on said drift vector and extends between two of said second set of samples.

23. The method of claim 1, wherein said corrected fault vector is equal to said uncorrected fault vector minus a first unit vector multiplied by a product of a second unit vector and said drift vector.

24. The method of claim 23, wherein:

said first unit vector corresponds to said drift vector; and

said second unit vector corresponds to said uncorrected fault vector.

25. The method of claim 1, further comprising:

performing a least square linear fit of said drift vector to said first set of samples;

if a result of said least square linear fit is less than a first predetermined value, setting said drift vector to zero;

if said result of said least square linear fit is greater than or equal to said first predetermined value, determining a correlation value based on (i) the first set of samples as projected onto said drift vector, and (ii) corresponding timestamps;

if the correlation value is less than a second predetermined value, setting said drift vector to zero; and

if the correlation value is greater than or equal to the second predetermined value, accepting said drift vector.