

CLAIMS

1. A system comprising:
 - a radio frequency (RF) generator configured to generate an RF signal;
 - an impedance matching circuit connected to the RF generator via an RF cable for receiving the RF signal, wherein the impedance matching circuit is configured to generate a modified signal from the RF signal;
 - a plasma chamber including an electrode, wherein the electrode is connected to the impedance matching circuit via an RF transmission line for receiving the modified signal; and
 - a host controller coupled to the RF generator, wherein the host controller is configured to:
 - receive a variable from the RF generator;
 - propagate the variable through a model of at least one of the RF cable, the impedance matching circuit, the RF transmission line, and the electrode;
 - count an output of the model for the variable to generate a count;
 - determine whether the count meets a count threshold;
 - generate a statistical value of the variable at the output of the model upon determining that the count meets the count threshold; and
 - send the statistical value to the RF generator to adjust the variable.
2. The system of claim 1, wherein the variable includes power, or frequency, or a voltage magnitude, or a current magnitude, or a phase between a complex voltage and a complex current, or a complex current, or a complex voltage, or a combination thereof.
3. The system of claim 1, wherein the model is a computer-generated model, wherein to propagate the variable through the model, the host controller is configured to generate a directional sum of a value of the variable and of variable values associated with components of the model.
4. The system of claim 1, wherein the output of the model includes multiple values of the variable.

5. The system of claim 4, wherein the statistical value includes a moving interquartile range of the values, or an interquartile range of the values, or a maximum of the values, or a minimum of the values, or a mean of the values, or a median of the values, or a variance of the values, or a standard deviation of the values, or a moving mean of the values, or a moving median of the values, or a moving variance of the values, or a moving standard deviation of the values, or a mode of the values, or a moving mode of the values, or a combination thereof.

6. A system comprising:

a radio frequency (RF) generator configured to generate an RF signal;

an impedance matching circuit connected to the RF generator via an RF cable for receiving the RF signal, wherein the impedance matching circuit is configured to generate a modified signal from the RF signal;

a plasma chamber including an electrode, wherein the electrode is connected to the impedance matching circuit via an RF transmission line for receiving the modified signal; and

a host controller coupled to the RF generator, wherein the host controller is configured to:

receive data associated with a variable from the RF generator;

generate values output from a computer-generated model based on the received data, wherein the computer-generated model is generated based on at least one of the RF cable, the impedance matching circuit, the RF transmission line, and the electrode;

count an amount of the values output from the computer-generated model;

determine whether the amount exceeds a count threshold;

generate a statistical value from the values output from the computer-generated model in response to determining that the amount exceeds the count threshold;

send the statistical value to the RF generator to adjust the RF signal generated by the RF generator.

7. The system of claim 6, wherein the variable includes power, or frequency, or a voltage magnitude, or a current magnitude, or a phase between a complex voltage and a complex current, or a complex current, or a complex voltage, or a combination thereof.
8. The system of claim 6, wherein the impedance matching circuit matches an impedance of a source with that of a load, wherein the source includes the RF generator and the RF cable, wherein the load includes the plasma chamber and the RF transmission line.
9. The system of claim 6, wherein the plasma chamber includes an upper electrode and a chuck facing the lower electrode, wherein the chuck includes the lower electrode.
10. The system of claim 6, wherein the variable includes a complex voltage and current at a point on the RF cable between the RF generator and the impedance matching circuit.
13. The system of claim 6, wherein the amount includes a number of the values, wherein the statistical value includes a moving interquartile range of the values, or an interquartile range of the values, or a maximum of the values, or a minimum of the values, or a mean of the values, or a median of the values, or a variance of the values, or a standard deviation of the values, or a moving mean of the values, or a moving median of the values, or a moving variance of the values, or a moving standard deviation of the values, or a mode of the values, or a moving mode of the values, or a combination thereof.
14. The system of claim 6, wherein the host controller is configured to decimate the data received after generating the statistical value.
15. A system comprising:
 - a radio frequency (RF) generator configured to generate an RF signal;
 - an impedance matching circuit connected to the RF generator via an RF cable for receiving the RF signal, wherein the impedance matching circuit is configured to generate a modified signal from the RF signal;
 - a plasma chamber including an electrode, wherein the electrode is connected to the impedance matching circuit via an RF transmission line for receiving the modified signal;
 - and

a host controller coupled to the RF generator, wherein the host controller is configured to:

- receive data associated with a variable from the RF generator;
- generate values at an output of a computer-generated model based on the received data, wherein the computer-generated model is generated based on at least one of the RF cable, the impedance matching circuit, the RF transmission line, and the electrode;
- count an amount of the values output from the computer-generated model;
- determine whether the amount exceeds a threshold;
- generate a statistical value from the values output from the computer-generated model in response to determining that the amount exceeds the threshold;
- determine whether the statistical value is outside a pre-determined range;
- adjust the statistical value to be within the pre-determined range in response to determining that the statistical value is outside the pre-determined range; and
- send the adjusted statistical value to the RF generator to control the RF generator to adjust the RF signal produced by the RF generator.

16. The system of claim 15, wherein the variable includes power, or frequency, or a voltage magnitude, or a current magnitude, or a phase between a complex voltage and a complex current, or a complex current, or a complex voltage, or a combination thereof.

17. The system of claim 15, wherein the impedance matching circuit matches an impedance of a source with that of a load, wherein the source includes the RF generator and the RF cable, wherein the load includes the plasma chamber and the RF transmission line.

18. The system of claim 15, wherein the plasma chamber includes a chuck and an upper electrode facing the chuck, wherein the chuck includes the lower electrode.

19. The system of claim 15, wherein the variable includes a complex voltage and current at a point on the RF cable.

20. A system comprising:

a radio frequency (RF) generator configured to generate an RF signal;

an impedance matching circuit connected to the RF generator via an RF cable for receiving the RF signal, wherein the impedance matching circuit is configured to generate a modified signal from the RF signal;

a plasma chamber including an electrode, wherein the electrode is connected to the impedance matching circuit via an RF transmission line for receiving the modified signal; and

a host controller coupled to the RF generator, wherein the host controller is configured to:

receive data associated with a variable from the RF generator;

generate values at an output of a computer-generated model based on the received data, wherein the computer-generated model is generated based on at least one of the RF cable, the impedance matching circuit, the RF transmission line, and the electrode;

count an amount of the values output from the computer-generated model;

determine whether the amount exceeds a count threshold;

generate a statistical value from the values output from of the computer-generated model in response to determining that the amount exceeds the count threshold;

determine whether the statistical value is outside a pre-determined extent;

generate an indication of a fault in response to determining that the statistical value is outside the pre-determined extent; and

send the fault indication to the RF generator.

21. The system of claim 20, wherein the host controller is configured to:

determine whether the statistical value is within a pre-determined range;

adjust the statistical value to be within the pre-determined range in response to determining that the statistical value is outside the pre-determined range; and

send the adjusted statistical value to the RF generator to control the RF generator to generate an adjusted RF signal to provide to the plasma chamber via the impedance matching circuit.

22. The system of claim 20, wherein the variable includes power, or frequency, or real portion of load impedance, and or imaginary portion of the load impedance, or a voltage magnitude, or a current magnitude, or a phase between a complex voltage and a complex current, or wafer bias, or ion energy, or plasma potential, or a complex current, or a complex voltage, or load impedance, or a combination thereof.

23. The system of claim 20, wherein the variable includes a complex voltage and current at a point on the RF cable.