CLAIMS

What is claimed is:

1. A system for generator-based charging of a battery module, the system comprising:

the battery module

a sensor located adjacent the battery module

a generator controller comprising a processor and a non-transitory memory device storing instructions that, when executed by the processor, cause the generator controller to:

analyze one or more sensor signals received from the sensor, the sensor signals corresponding to a condition of the battery module;

calculate, based on the one or more sensor signals, a generator current value for use in charging the battery module;

calculate, based on the one or more sensor signals, a generator voltage value for use in charging the battery module; and

generate a control signal comprising a command to control a generator field excitation current to provide the current value based on a current control loop and a voltage control loop, wherein the voltage control loop operates faster than the current control loop.

2. The system of claim 1, wherein the sensor comprises a number of sensors for sensing a plurality of battery conditions and a processor capable of determining a state of charge of the battery module based on the plurality of battery conditions.

3. The system of claim 1, further comprising a non-transitory memory device storing a plurality of charging profiles associated with one or more different battery module configurations.

4. The system of claim 1, wherein the battery module comprises a Li-ion battery.

5. The system of claim 1, wherein the voltage control loop is processed at a first frequency and the current control loop is processed at a second frequency and wherein the first frequency is greater than the second frequency.

6. The system of claim 1, wherein the current value is associated with a plurality of battery parameters sensed in near real time.

7. The system of claim 1, wherein operational timings of one or both of the voltage control loop and the current control loop change over time based as a function of one or more system or battery parameters.

8. A method for generator-based charging of a battery module, the method comprising:

analyzing one or more sensor signals received from the sensor, the sensor signals corresponding to a condition of the battery module;

calculating, based on the one or more sensor signals, a generator current value for use in charging the battery module, wherein the generator current value is determined based on a charging profile;

calculating, based on the one or more sensor signals, a generator voltage value for use in charging the battery module; and

generating a control signal comprising a command to control a generator field excitation current to provide the current value based on a current control loop and a voltage control loop, wherein the current control loop operates at a slower frequency than the voltage control loop.

9. The method of claim 8, comprising:

identifying, by the controller, a configuration of the battery module; and

identifying, by the controller, a charging profile for use in charging the battery module based on the configuration of the battery module and the sensor signals received from the sensor.

10. The method of claim 8, comprising:

retrieving, from the battery module, the charging profile for use in charging the battery module based on a configuration of the battery module and the sensor signals received from the sensor.

11. The method of claim 8, wherein a configuration of the battery module comprises a single battery type and the command signal corresponds to a current command to provide a specified output current based on a sensed voltage.

12. The method of claim 8, wherein a configuration of the battery module comprises a single battery type and the command signal corresponds to a command to output a specified output current based on a sensed voltage and a sensed temperature.

13. The method of claim 8, wherein the configuration of the battery module comprises a plurality of batteries and the command signal corresponds to a condition of a particular battery of the plurality of batteries.

14. The method of claim 8, wherein the voltage control loop is processed at a first frequency and the current control loop is processed at a second frequency.

15. A controller for a generator to charge a battery module, the controller comprising:

a processor; and

a non-transitory memory device storing instructions that, when executed by the processor, cause the controller to:

analyze one or more sensor signals received from the sensor, the sensor signals corresponding to a condition of the battery module;

calculate, based on the one or more sensor signals, a generator current value for use in charging the battery module, wherein the generator current value is limited based on a first charging profile;

calculate, based on the one or more sensor signals, a generator voltage value for use in charging the battery module; and

generate a control signal comprising a command to control a generator field excitation current to provide the current value based on a current control loop and a voltage control loop, wherein the voltage control loop operates faster than the current control loop.

16. The controller of claim 15, wherein the instructions, when executed by the processor, cause the controller to:

sense, in near real time, a plurality of battery module parameters including battery module current, battery module voltage, and battery module temperature; and

identify, based on a sensed plurality of battery module parameters whether a threshold condition has been reached; and

if so, select, based on the sensed plurality of battery module parameters, a second charging profile; and

identify, based on the sensed plurality of battery module parameters, a second generator output using on the second charging profile in near real-time, and

communicate, to the generator, a second command for the generator to output the identified second generator output.

17. The controller of claim 16, wherein the threshold condition corresponds to a temperature threshold.

18. The controller of claim 16, wherein the threshold condition corresponds to a current threshold.

19. The controller of claim 16, wherein the voltage control loop is processed at a first frequency and the current control loop is processed at a second frequency, wherein the battery module is charged to a desired voltage level, while controlling the battery charging current and keeping the voltage at a voltage set point after an initial ramp up period.

20. The controller of claim 19, wherein the plurality of sensed signals is sensed using a smart sensor installed adjacent to the battery module, and wherein the smart sensor communicates a message to the controller including a state of charge of the battery module calculated using the plurality of sensed signals.