What is claimed is:

1. A method comprises:

obtaining by a data processing apparatus, battery data comprising voltage values corresponding to operating states of a battery;

selecting by the data processing apparatus, a battery model having convex parameters that exhibit convexity with respect to differences between the battery data and battery data predictions and non-convex parameters;

assigning by the data processing apparatus from a parameter selector, a set of convex and non-convex parameters, by:

fitting the convex parameters to the battery data for fixed values of the non-convex parameters,

fitting the non-convex parameters to the battery data, and

producing an electro-thermal model for the battery from the selected battery model using the fitted values of the convex parameters and the fitted values of the non-convex parameters.

2. The method of claim 1, wherein fitting of the non-convex parameters occurs prior to fitting of the convex parameters; and

fitting of the convex parameters occurs with the non-convex parameter values being determined.

3. The method of claim 2, wherein the fitting the non-convex parameters continues until values of a cost function satisfies a predefined threshold.

4. The method of claim 1, wherein a nested loop procedure is executed in which the convex parameters are fit with respect to the battery data using an inner loop during which the non-convex parameters are held fixed, and the non-convex parameters are fit with respect to the battery data using an outer loop.

5. The method of claim 1, wherein obtaining battery data further comprises:

obtaining, by the data processing apparatus, temperature values corresponding to operating states of the battery; and

the battery model includes an electrical model and a thermal model, with the electrical model configured to predict battery voltage and heat generation, and the thermal model configured to predict temperature based on the heat generation, with a difference between a predicted temperature and the temperature values is an input to assigning the set of convex and non-convex parameters.

6. The method of claim 1, wherein the battery model uses basis vector functions to represent the at least one convex parameter over a range of battery states and the battery state includes at least one of battery temperature, state of charge, and age.

7. The method of claim 5, wherein difference between the predicted temperature and the temperature data is included in a cost function used in assigning the set of convex and non-convex parameters.

8. The method of claim 1, wherein the battery data is collected from multiple, different batteries.

9. The method of claim 1, where the battery data is collected from a plurality of thermal environments.

10. The method of claim 1, wherein the battery data is collected from multiple measurement systems.

11. The method of claim 1, further comprising encoding the electro-thermal model in electronics to monitor battery performance in an automobile.

12. The method of claim 1, further comprises encoding the electro-thermal model in electronics to monitor battery performance in a mobile electronic device.

13. The method of claim 1, further comprising a simulation system configured to execute a numerical simulation of a battery.

14. The method of claim 1, wherein selecting the battery model comprises comparing a plurality of battery models and selecting the battery model having the lowest cost function.

15. The method of claim 1, wherein the at least one convex parameter is selected based on a convex cost function.

16. The method of claim 1, wherein selecting the battery model comprises comparing determined non-convex parameters to a threshold.

17. The method of claim 1, wherein selecting the battery model comprises:

determining a ratio between the non-convex parameters and the convex parameters; and

comparing the determined ratio to a threshold.

18. The method of claim 1, wherein the electro-thermal model is predictive over a continuous range of battery operating states.

19. The method of claim 2, wherein the fitting enables efficient processor use by selecting the non-convex parameters prior to selecting the convex parameters.

20. The method of claim 1, wherein the operating state of the battery comprises at least one of temperature, electrical current, and state of charge.

21. A system comprises:

a processor and a memory operatively coupled to the processor, with the processor and memory being configured to execute instructions to:

obtain battery data comprising voltage values corresponding to operating states of a battery;

select a battery model, the battery model having convex parameters that exhibit convexity with respect to differences between the battery data and battery data predictions and non-convex parameters;

assign from a parameter selector, a set of convex and non-convex parameters, by instructions to:

fit the convex parameters to the battery data for fixed values of the non-convex parameters, and

fit the non-convex parameters to the battery data, and produce an electro-thermal model for the battery from the selected battery model using the fitted values of the convex parameters and the fitted values of the non-convex parameters.

22. A non-transitory computer-readable data storage medium storing computer-executable instructions for simulating fluid flow and acoustic interaction of a fluid with a porous medium that, when executed cause a computer to:

obtain battery data comprising voltage values corresponding to operating states of a battery;

select a battery model, the battery model having convex parameters that exhibit convexity with respect to differences between the battery data and battery data predictions and non-convex parameters;

assign from a parameter selector, a set of convex and non-convex parameters, by instructions to:

fit the convex parameters to the battery data for fixed values of the non-convex parameters,

fit the non-convex parameters to the battery data, and produce an electro-thermal model for the battery from the selected battery model using the fitted values of the convex parameters and the fitted values of the non-convex parameters.