CellSage™

Battery Health Analysis and Prognostics Software

Features and Benefits

- Addresses diagnostic and prognostic evaluations of battery based energy systems, including capacity fade.
- Helps to optimizes battery life by investigating Thermal Management (TM), effects of different geographic regions, string anomalies, and other customized operating conditions observed with complex duty cycles.
- More than 20 environmental and operational parameters, including battery chemistry, State of Charge (SoC), thermal cycling, and detailed cycling conditions are taken into account.
- Powerful software analysis covering annual temperature profiles in over 130 U.S. cities, and can easily expand the list to include any global geographic region.

General Description

CellSage is an advanced battery and cell aging software simulation tool that represents over a decade of research in electrochemistry, physics, and thermodynamics. CellSage utilizes advanced diagnostics and predictive modeling techniques to achieve a better understanding of incident precursors, as well as providing critical simulation results that help to optimize repair and maintenance strategies for battery based energy systems.

Technology Overview

CellSage can take into account more than 20 environmental and operational parameters, including battery chemistry, temperature conditions, thermal cycling, and cell string configuration. CellSage calculates a multitude of vital health metrics and aging effects, including SoC, capacity loss, cell/battery conductance loss, and power fade.

Under license from the U.S. Department of Energy's Idaho National Laboratory (INL), Ridgetop Group has enhanced the underlying CellSage technology core and its advanced sigmoidal progression algorithms to provide end users with easy-to-understand metrics, indicators, and alerts that show the battery's capacity at any point in time and computing remaining useful life (RUL) based on the simulated impacts of real world aging conditions and stress factors. Through an intuitive graphical user interface (GUI), CellSage end users are presented a clear picture of how the battery is aging and an accurate projection of how long the battery will last for a simulated duty cycle or mission.

In addition to its application for studying batteries that are already in use, CellSage can also simulate "what if" scenarios to weigh the impact of operational and environmental parameters on battery performance and health. Such insights help to select the most appropriate battery for a target application, and can help to determine what secondary use cases are feasible.

Battery Management Systems

The shift to clean renewable energy is an ongoing process, and batteries are destined to play a major role in the transition as they are relied upon for everything from powering personal communication devices and running fully electric or hybrid-electric vehicles, to providing backup grid energy storage. Until recently, there has a been a lack of technology advancements that help mature Battery Management System (BMS) strategies and CellSage is poised to help bridge this critical gap in multiple ways.

As a software simulation tool CellSage outputs can already be used to help customers study, revise, and optimize their BMS strategies. The development of a CellSage enabled BMS is another type of integration, that would enable the near real-time comparison of actual BMS data versus the CellSage prediction model. Such integrations aid in the development of new or revised methods of monitoring individual cell voltages, SoC, and other key parameters at both the module and system levels. To meet in the field demands, a CellSage enabled BMS also helps to control an adaptive recharging protocol that accommodates a variety of battery cells and can be dynamically adjusted to eliminate problems with over overcharging, undercharging, and having a mix of old and new batteries with varying voltage output levels.

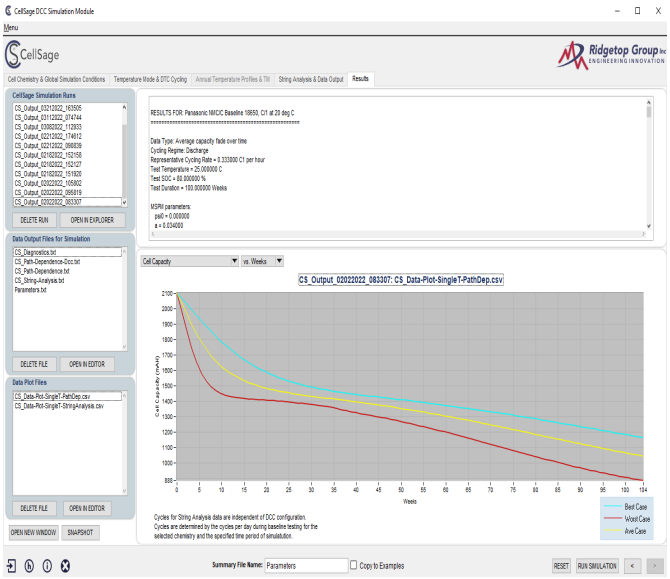
CellSage Applications

Electric Vehicles (EVs)	Grid Energy Storage
Military Applications	Consumer Electronics

Commercial Impact

Targeted within several different energy storage sectors, there is a pressing need for innovative tools like CellSage involving grid/micro-grid systems, electric vehicles, critical military assets, and other applications where high-fidelity evaluations of battery health is required.

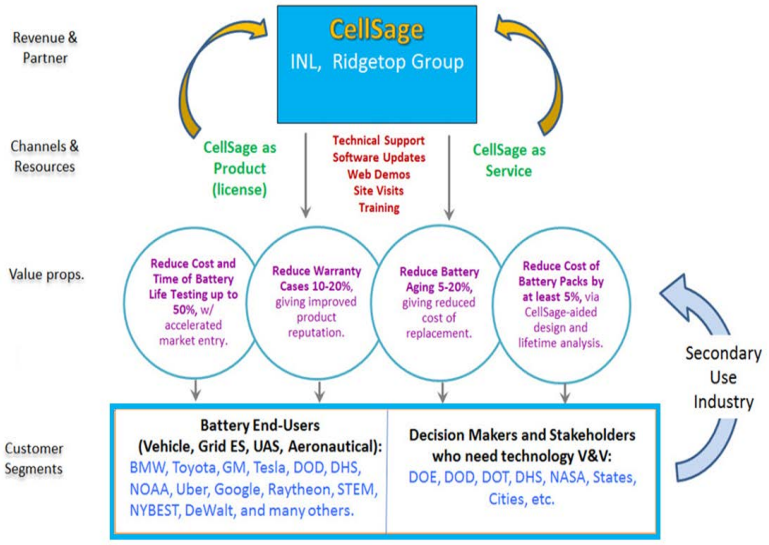
By utilizing a proven scientific and mathematical approach to both battery diagnostics and prognostics, CellSage helps battery engineers and researchers determine optimal BMS strategies and replacement schedules for high-cost battery systems. In addition to helping with the early determination of such large expenditures, its small computing footprint also makes it feasible for use on laptop PCs, desktops, and other architectures for greater commercialization options. The following visual shows the capacity loss and other CellSage simulation results during a 2-year period for an NMC/graphite chemistry (Panasonic UR18650) that is utilized in many consumer electronics.



Commitment to Industry

Ridgetop Group, Inc. is a technology leader in advanced diagnostics and prognostic solutions for complex systems. In order to cover an exponentially growing list of broad commercial applications, Ridgetop Group has worked closely with industry partners to modify and enhance CellSage to meet diverse application needs and requirements.

As a result of these engagements with industry, Ridgetop is proud to offer CellSage as one of the first commercially available software simulation tools that can accurately model and predict how a particular battery cell and chemistry will age and degrade under real world operating conditions. The technology core is covered by 5 U.S. Patents, and supported by nearly two decades of research and development at Idaho National Laboratory (INL) and Ridgetop. CellSage simulation results have been proven to provide key diagnostics of aging mechanisms, predictions of RUL, evaluation of kinetic (power) performance, and determination of mitigating conditions for extending battery life and operational performance. Ridgetop Group will continue its commitment to industry as we aim to set CellSage as an industry standard for battery diagnostics and prognostics.



About Ridgetop Group

Founded in 2000, Ridgetop Group, Inc. (Ridgetop) is a well-established engineering and technology firm that provides advanced Condition-based Maintenance (CBM), Prognostic Health Management (PHM), and reliability engineering solutions for its customers. Ridgetop's solutions aim to increase safety, efficiency, and operational performance while also reducing maintenance and sustainment costs with the most innovative products and technology for aerospace, defense, transportation, energy, and industrial applications.

Corporate Headquarters

3580 West Ina Road

Tucson, Arizona 85741 USA

OFFICE +1 520 742 3300

INFO@RIDGETOPGROUP.COM

Worldwide Locations

Ridgetop Group Inc. has support and sales locations in the USA, Europe, and Asia.

For office locations and contact information, please call the corporate headquarters or visit us on the web: **www.ridgetopgroup.com**