SWR-22-69 Marketing Summary

BLAST-Py (Battery Lifetime Analysis and Simulation Tool Suite - Python)

Prepared by Noah Kobayashi, 08/09/2022

*Title*

BLAST-Py (Battery Lifetime Analysis and Simulation Tool Suite - Python)

*Summary*

Batteries are one of the leading cost drivers of any electric vehicle project. Current practices require that batteries be oversized by design in order to meet the battery warrantee’s end-of-life (EOL) power and energy requirements. This quickly increases the cost of electric vehicles and can price them out of the realm of consideration for most users. NREL scientists have developed a software model that analyzes the performance of batteries over a lifetime of use in real world environmental and loading scenarios. This model allows users to simulate the lifetime performance requirements of a battery and minimize the size and cost of a battery that is needed to meet user requirements. NREL is seeking partners and/or licensees to further develop, test, and support the software for widespread distribution.

*Description*

The battery life predictive model provides a method to estimate capacity fade and resistance growth of a battery under real world usage cycles and temperature conditions. The model uses an extensive database of previous Department of Energy (DOE) battery aging experiments, released data from private partnerships, or open-source data as the basis for identifying a series of empirical models to produce accurate estimates of battery life under real world conditions. The model requires performance inputs from past experiments for operating temperature, voltage, depth of discharge and the number of cycles/charge-throughput per day and analyzes the effect of those inputs on battery performance based on a user defined driving requirements profile. The model will output the increase in battery resistance and the reduction in capacity over time or a given number of cycles.  
  
Most currently available models allow the designer to only analyze battery life for a few limited scenarios that closely correspond to experimentally tested conditions. This limitation does not provide a true “real world” simulation of the factors that affect battery performance. NREL’s Battery Life Predictive Model has the unique ability to allow the user to change multiple constraints at once to get an accurate simulation of the desired operating scenario. NREL’s model targets users looking to run performance/life/cost tradeoff analyses or determine the appropriate battery that must be used in an application to meet end of life performance goals. The model also enables users to fit specific scenarios and perform business case analyses.

Additional capabilities that may be implemented into BLAST include module or pack level thermal models parameterized from various testing data, battery performance modeling using equivalent circuits parameterized from DC pulse or AC impedance data, and electrode-level health modeling using incremental capacity analysis to diagnose cell performance.

To learn more about BLAST-Py (Battery Lifetime Analysis and Simulation Tool Suite - Python), please contact Jean Schulte at:

Jean.Schulte@nrel.gov

SWR-22-69.

*Benefits*

* Enables users to adjust a wide variety of inputs to simulate real world battery usage conditions.
* Uses a large database of battery aging data, combined with physically justified empirical models and machine-learned models to predict battery life.

*Applications and Industries*

* Battery performance tradeoff analysis (“what if” analysis).
* Determining battery size requirements to meet end of life goals.
* Warranty, second use analysis.
* Could be developed into an on board power management program.

*Available hashtags and hashtag categories for LPS Marketing Summaries. (Highlighted tags have been selected for your review)*

* Aerospace & Defense
  + Autonomous Systems
  + Launch Systems
  + Physical Security
  + Radar & Optics
  + Sensors & Detectors
  + Space Systems
  + Other
* Artificial Intelligence
  + AI
  + Machine Learning
  + Natural Language Modeling
  + Neural Network
* Automotive
  + Alternative Fuels
  + Autonomy and Sensing
  + Combustion and Fuel
  + Electric Vehicles
  + Transportation Infrastructure
  + Other
* Biomanufacturing
  + Agriculture
  + Algae
  + Biobased Chemicals and Materials
  + Biomanufacturing at Scale
  + Biomass & Biofuels
  + Biosecurity
  + Proteins & Enzymes
  + Synthetic Biology
* COVID-19
  + Decontamination
  + Diagnostics
  + Discovery Research
  + Epidemiology Tools
  + Medical Devices and Supplies
  + Other Modeling and Simulation
  + Pharmaceuticals and Therapeutics
  + Population Dynamics
  + Social Consequences
* Carbon Dioxide Removal
  + Analysis
    - Cost Assessment/Technoeconomic Analysis
    - Durability and Permanence Analysis
    - Lifecycle Analysis
    - Monitoring, Reporting, and Verification
  + Durable Storage
    - Geologic Storage
    - Value-added Products with Long-Term Storage
  + Land-based Carbon Dioxide Removal
    - Afforestation/Deforestation
    - Soil Carbon Sequestration
  + Ocean-based Carbon Dioxide Removal
    - Blue Carbon
    - Direct Ocean Capture and Storage
    - Ocean Alkalinity Enhancement
  + Technology-based Carbon Removal
    - Bioenergy with Carbon Capture and Storage/Biomass Carbon Removal and Storage
    - Direct Air Capture and Storage
    - Enhanced Mineralization/Enhanced Weatherization
* Climate
  + Adaptation
    - Community and Infrastructure Resilience
    - Green Workface Development
    - Human Health Impacts of Climate Change
    - Risk Assessment
    - Sustainable Agriculture
  + Intervention
    - Carbon Dioxide Removal
    - Geoengineering
    - Sensors and Controls
  + Mitigation
    - Alternative Fuels
    - Carbon Dioxide Removal
    - Climate Economics
    - Electric Vehicles
    - Fossil Energy
      * Emissions Technologies
      * Enhanced Oil Recovery
      * Oil & Gas
      * Subsurface
    - Lifecycle Analysis
    - Nuclear Energy
      * Advanced Nuclear Calculations
      * Advanced Nuclear Reactors
      * Existing Nuclear Reactors
      * Other Nuclear Energy
    - Renewable Energy
      * Biomass & Biofuels
      * Critical Materials
      * Geothermal Energy
      * Hydropower
      * Solar Energy
      * Wind Energy
  + Situational Awareness and Prediction
    - Aerosols and Clouds
    - Climate Modeling and Data Science
    - Computational Environmental Science
    - Ecosystem Effects and Impacts
    - Ice Sheet and Glacier Decline
    - Ocean and Coastal Processes
    - Paleoclimate Studies
    - Water Cycle and Precipitation
* Energy & Utilities
  + Building Technologies
  + Electric Grid
  + Energy Analysis
  + Energy Efficiency
  + Energy Policy
  + Energy Storage
    - Chemical and Hydrogen Storage
    - Electrical Storage Systems
    - Electrochemical/Battery Systems
    - Grid Integration
    - Life Cycle and Secondary Use
    - Mechanical Storage Systems
    - Safety and Reliability
    - Thermal Storage
  + Fossil Energy
    - Emissions Technologies
    - Enhanced Oil Recovery
    - Oil & Gas
    - Subsurface
  + Nuclear Energy
  + Power Electronics
  + Renewable Energy
    - Biomass & Biofuels
    - Critical Materials
    - Geothermal Energy
    - Hydropower
    - Solar Energy
    - Wind Energy
  + Other
* Energy Storage Grand Challenge
  + Bidirectional Electrical Storage
    - Electrical Storage Systems
    - Electrochemical/Battery Systems
    - Life Cycle and Secondary Use
    - Mechanical Storage Systems
  + Chemical and Thermal Storage
    - Chemical and Hydrogen Storage
    - Thermal Storage
  + Flexible Generation and Controllable Loads
    - Grid Integration
  + Policy and Valuation
  + Power Electronics
* Healthcare & Life Sciences
  + Chemical and Biotechnology
  + Decontamination
  + Diagnostics & Testing
  + Medical Devices and Supplies
  + Pharmaceuticals and Therapeutics
  + Other
* High Energy Physics
  + Accelerator Technologies
  + Extreme Environments
  + Lasers
  + Physics Codes
  + Thermodynamics
  + Other
* Hydrogen
  + Chemical and Hydrogen Storage
  + Hydrogen Applications
  + Hydrogen Conversion
  + Hydrogen Delivery
  + Hydrogen End uses
  + Hydrogen Production
    - Advanced Pathways
    - Electrolysis
    - Thermal Conversion with Carbon Capture and Storage
* Information & Communications Technology
  + Computer Hardware
  + Cybersecurity
  + Data Processing and Analytics
  + High Performance Computing
  + Internet of Things
  + Software
  + Telecommunications
  + Other
* Manufacturing & Industrial
  + Additive Manufacturing and 3D Printing
  + Advanced Materials
  + Automation and Robotics
  + Process and Design
  + Other
* Materials Science
  + Advanced Materials
  + Materials Discovery and Characterization
  + Stress and Damage
  + Other
* Micro & Nanotechnology
  + MEMS
  + Microscopy
  + Nanomaterials and Nanofabrication
  + Semiconductors
  + Spectroscopy
  + Other
* Quantum
  + Quantum Computing Software, Architecture and Simulation
  + Quantum Hardware
  + Quantum Materials and Sensing
  + Quantum Networking and Communication
  + Qubit Technologies