

## Title: Battery Health Assessment by Deep Neural Networks

### Abstract:

The ability to predict the state of health (SOH) and residual useful life (RUL) of batteries with minimal data could offer substantial economic and environmental benefits, particularly in the fields of energy, environmental protection, and automotive safety. However, accurately predicting battery health under complex usage scenarios presents several significant challenges, such as partial charging and discharging processes, random charging policies, and the availability of limited labeled data.

In recent years, our research teams have developed several approaches to address these challenges. For example, a model capable of predicting the RUL of a battery based on data from just one cycle has achieved a root mean square error (RMSE) of fewer than 58 cycles, compared to an average battery life of 805 cycles. However, this model faced limitations when applied to practical situations such as electric vehicles (EVs), where the unpredictable nature of charging and discharging processes complicates accurate predictions. To address this, a self-supervised deep learning model was further developed to assess battery health using only short-term voltage and current curves, offering a solution to the unpredictable and complex charging scenarios faced in real-world applications. Preliminary results, validated using conventional battery datasets available online, demonstrate the potential success of this design.

The combined outcomes of these efforts have the potential to improve the way battery health is monitored and managed, paving the way for more reliable and efficient energy storage systems that can be widely applied across various industries, from automotive to environmental protection.