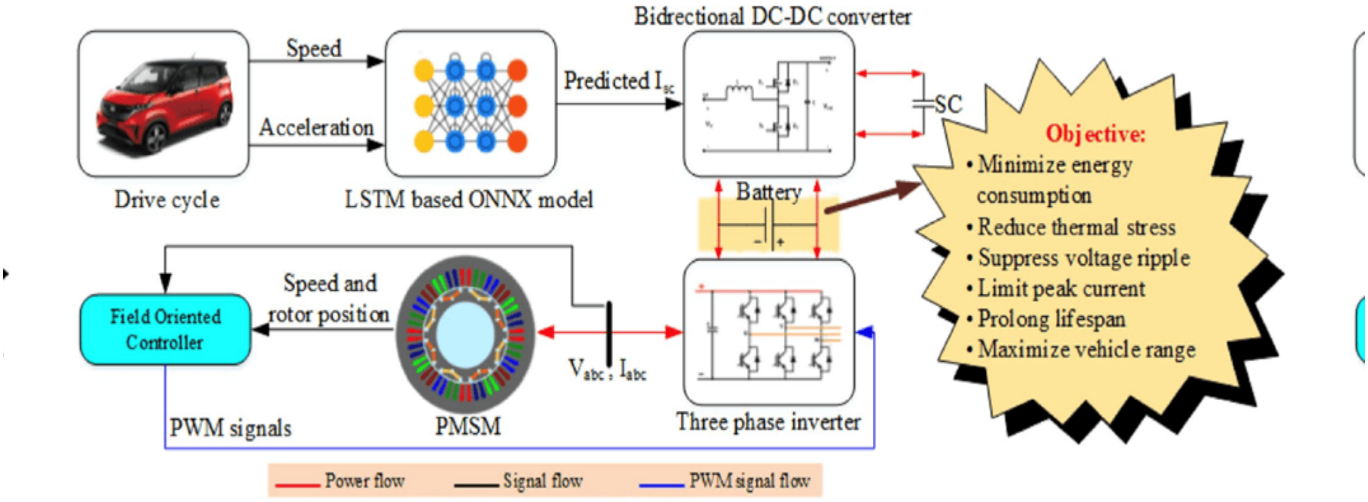

Fig. 1. Graphical abstract of the proposed ONNX-deployed LSTM-based SC current prediction framework for EVs.

How Machine Learning Can Reduce Battery Stress and Energy Use in EVs

Posted on 19.Jan 2026

Image: Scientific Reports T. Paulraj & Yeddula Pedda Obulesu

Machine learning-based approach for reduction of energy consumption in hybrid energy storage electric vehicle.

Electrification is progressing rapidly — but the real-world challenge is not only how to power vehicles, it is also **how to manage energy intelligently**. Batteries remain the backbone of electric mobility, yet they are exposed to frequent high-power transients: aggressive acceleration, stop-and-go traffic, and regenerative braking spikes. These events drive **peak current, heat, voltage ripple and long-term degradation**.

A recent *Scientific Reports* study proposes a practical solution: **hybrid energy storage** combining a lithium-ion battery with a supercapacitor — coordinated by a machine learning-based control strategy that can run in real time.

The core idea: let the battery do “energy”, let the supercapacitor do

“power”

Supercapacitors are highly effective for short bursts of power. In a hybrid energy storage system (HESS), the battery provides steady energy, while the supercapacitor buffers fast transients — both during acceleration and regenerative braking. The key challenge is energy management: deciding **how much current the supercapacitor should supply or absorb at each moment**.

The study introduces an approach that generates the supercapacitor reference current using a **Long Short-Term Memory (LSTM)** neural network trained on drive-cycle data (speed and acceleration). The trained model is exported into **ONNX format** and integrated into **MATLAB/Simulink via an ONNX Predict block** for real-time execution in a control loop. This is important: many AI-based strategies remain “paper-only” due to deployment complexity — ONNX integration directly addresses that gap.

What was tested

The authors model an EV powertrain based on the **Nissan Sakura EV** in Simscape and compare:

- A battery-electric configuration (BEV)
- A hybrid battery + supercapacitor configuration (HBEV), using the proposed LSTM+ONNX control

Performance is evaluated on two standard drive cycles:

- **EUDC** (mixed urban/highway dynamics)
- **IM240** (highly transient, stop-and-go style dynamics)

Quantified results: less peak stress, less energy consumption

The reported improvements are substantial and consistent with what hybrid energy storage is designed to do:

EUDC cycle:

- Battery peak current reduced by **21.3%**
- Peak battery power reduced by **18.1%**
- Battery energy consumption reduced by **5.75%**

IM240 cycle:

- Battery peak current reduced by **33.5%**
- Peak battery power reduced by **31.6%**
- Battery energy consumption reduced by **12.36%**

The paper also reports improvements in battery **voltage ripple** and **battery temperature**, reflecting reduced electrical and thermal stress when the supercapacitor absorbs transient power exchange.

Why this matters for real-world decarbonisation

For fleets and consumers, EV performance is not just about maximum range under ideal conditions. It is about:

- **Efficiency in real duty cycles**
- **Battery lifetime and thermal robustness**
- **Stable power delivery and drivability**

Hybrid energy storage is a practical, technology-neutral lever that can improve EV operation today — and machine-learning-based control can make it adaptive without fragile, hand-tuned rule sets. The study explicitly positions the contribution as bridging research gaps around **real-time feasibility**, **Simulink integration**, and the combined evaluation of **electrical + thermal impacts**.

Hybrid Alliance takeaway

The energy transition will not be driven by one component alone. It will be driven by **system-level engineering**:

- Better power electronics
- Smarter control strategies
- Hybrid architectures that reduce stress and improve efficiency

This research underlines a key point: **hybrid solutions exist inside EVs as well** — and they can meaningfully improve performance and energy use under dynamic, real-world conditions.

Read more – source: [Machine learning-based approach for reduction of energy consumption in hybrid energy storage electric vehicle | Scientific Reports]