Boost Converter Methods and System

Tech ID: 32894 / UC Case 2022-816-0

BACKGROUND

Electric vehicle (EV) energy systems (fuel cell, battery, supercapacitor) demand power conversion technologies that can vary voltage based on the load or state of charge. This means operating in a dynamic operating environment such as supplying energy during acceleration and storing it during braking. DC-DC boost converters are a widely used component in the power systems of EVs to step the voltage between input (supply) to output (load) during charge-discharge periods. Traditional voltage/current controls for DC-DC converters utilize pulse-width modulation (PWM) controls. While PWM has worked well in the past, it lacks practical stability range under uncertain operating parameters due to its reliance on linearized models of DC-DC converter dynamics.

TECHNOLOGY DESCRIPTION

To overcome this problem, researchers at UC Santa Cruz have developed a new approach to accommodate the transient behavior and every possible state of the boost converter. By combining two feedback controllers and requisite logic, recent research data suggest broad converter stability even under uncertainty in the input voltage and load resistance. This control framework involves switching between global and local controls, with the global scheme inducing practical asymptotic stability of a desired output voltage (and corresponding current) and the local control scheme maintaining industry-standard PWM behavior during steady state. These preliminary research results hold promise for EV and other systems requiring efficient and high-performance DC-DC conversion.

APPLICATIONS

- Automotive
- Aviation
- Aerospace
- Electric grid / power distribution
- General: power amplifiers
- General: storage power/charging systems
- General: DC motor drives
- General: consumer electronics

FEATURES/BENEFITS

- No specialized hardware / interoperable with standard microcontrollers
- Ensures stability over a wider operating range than PWM control
- Plug and play architecture

INTELLECTUAL PROPERTY INFORMATION

Patent Pending

RELATED MATERIALS

- Johnson, Ryan S., Berk Altin, and Ricardo G. Sanfelice. "Hybrid Adaptive Control for the DC-DC Boost Converter." IFAC-PapersOnLine 54.5 (2021): 73-78. - 09/09/2021

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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OTHER INFORMATION

KEYWORDS

electrical circuits, energy, power, hybrid, cyber-physical, electric vehicle, DC-DC boost, PWM, DC-DC convert, asymptotic stability, asymptotic, stability, battery, fuel cell, supercapacitor

CATEGORIZED AS

- **Computer**
  - Hardware
  - Software
- **Sensors & Instrumentation**
  - Process Control
- **Transportation**
  - Aerospace
  - Automotive
- **Engineering**
  - Other

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