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| **Abstract:** |  |
| Regenerative braking (RB) is crucial in enhancing the efficiency and sustainability of electric vehicles (EVs) by converting kinetic energy into usable electric energy during braking. However, current systems face challenges in maximizing energy recovery and managing power effectively. This research presents an optimized regenerative braking system that combines the benefits of supercapacitors and Brushless DC (BLDC) motors to improve energy recovery efficiency. The study introduces advanced control algorithms for BLDC motors to ensure precise and reliable operation across various driving conditions. Furthermore, refined power management strategies are developed to optimize energy storage between supercapacitors and batteries, enhancing overall system efficiency. The proposed model employs modern control techniques and power management solutions, allowing for real-time energy optimization during braking. With an overall energy recovery efficiency of 92.5%, the system shows significant promise in minimizing energy losses and supporting the sustainability goals of electric vehicles. | |