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| **Abstract:** |  |
| Power instability in centralized microgrids remains a critical challenge due to fluctuating load demands and the dynamic nature of renewable energy sources. Traditional voltage and frequency control techniques often fail to tackle imbalances arising from uneven load distribution and dynamic generation patterns. To overcome this, the study introduces an advanced control strategy incorporating a novel centralized secondary control mechanism. This mechanism optimizes power management by factoring in intermittent levels, load-effective impedance, and voltage fluctuations, ensuring efficient voltage regulation and stability. The proposed approach aims to improve overall microgrid performance by dynamically balancing power distribution and enhancing control parameters. The effectiveness of the strategy is validated through simulation and experimental methods, demonstrating its ability to stabilize voltage and address power imbalances in centralized microgrids. The findings provide valuable insights for improving the reliability and efficiency of modern energy systems, particularly in dealing with voltage instability and variable load conditions in microgrid applications. | |