Study Committee C6

PS3 SIMULATION TOOLS PARTNERED WITH MEASUREMENT TECHNIQUES

C6_PS3_10417_2022

Research on Operation Control Strategy of Low-voltage DC Microgrid Based on Improved Droop Method

Xiangbiao. Leng1, Kang. Chen2, Fei. Peng1, Haixiang. Yu1, Junxin. Niu1, Wenlong. Zeng1, Qiaozhang. Hong1

1. China Southern Power Grid Energy Development Research Institute Co., Ltd. China

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Motivation

- low-voltage DC microgrid and the control method：
- Island operation mode;Grid-connected operation mode.

Experimental setup & test results

- Isolated Island operation control strategy for DC microgrid
- Control strategy for grid-connected operation of DC microgrid

Method/Approach

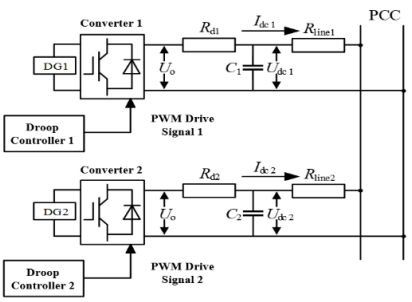
- Improved hierarchical control algorithm
- Control strategy for grid-connected operation of DC microgrid

Discussion

- Islanded operation mode
- Grid-connected operation mode

Objects of investigation

- Simulation Analysis



Conclusion

- (1) An improved droop control algorithm based on fuzzy logic is proposed for isolated island operation mode. The droop resistance is adjusted by outputting the virtual compensating resistance of the fuzzy logic controller. Hence, the droop curve is improved and the current sharing accuracy and voltage regulation ability of the system are improved.
- (2) A pre-synchronization control algorithm based on CMAC and traditional PID compound adaptive control algorithm is proposed for grid-connected operation mode. The output voltage of the grid-connected inverter can track the voltage of the main network quickly and accurately. Besides, the safe switch of the microgrid from island mode to grid-connected mode could be realized. Simulation results verify the effectiveness of the proposed algorithm.

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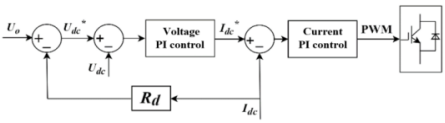
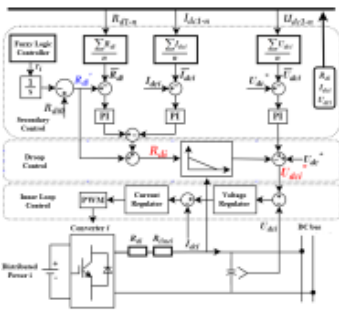
Isolated Island operation control strategy for DC microgridHeadline

- DC droop control principle and limitation



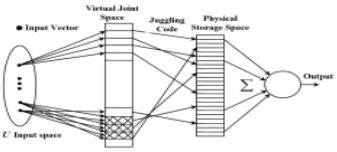
Isolated Island operation control strategy for DC microgridHeadline

- Improved hierarchical control algorithm for droop control based on fuzzy logicdescription



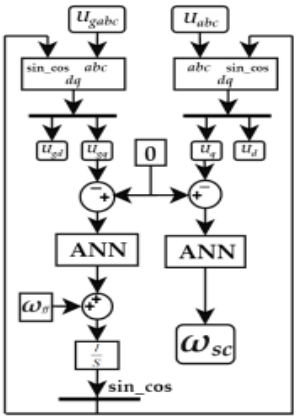
Control strategy for grid-connected operation of DC microgrid

- Control structure of CMAC



Control strategy for grid-connected operation of DC microgrid

- Pre-synchronization Control Algorithm



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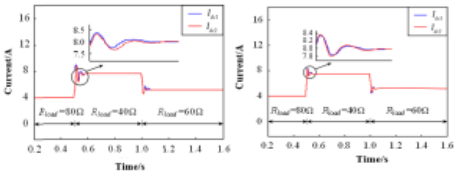
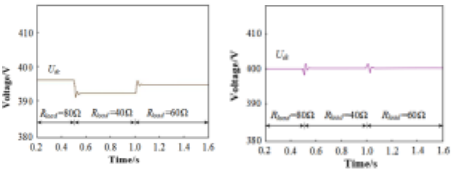
Islanded operation mode

- Case1(Fig.15 Current distribution(traditional),Fig.16 Current distribution(proposed)



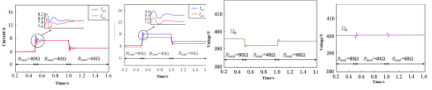
Islanded operation mode

- Case1(Fig.17 Bus voltage(traditional),Fig.18 Bus voltage(proposed))

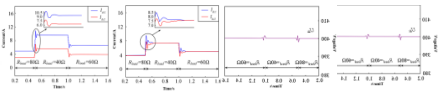


• Islanded operation mode

- Case2(Fig.19 Current distribution(traditional),Fig.20 Current distribution(proposed),Fig.21 Bus voltage(traditional),Fig.22 Bus voltage(proposed).

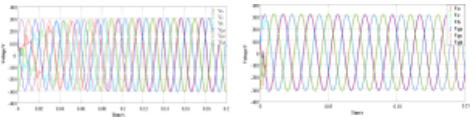


- Case3(Fig.23 Current distribution(traditional),Fig.24 Current distribution(proposed),Fig.25 Bus voltage(traditional),Fig.26 Bus voltage(proposed).



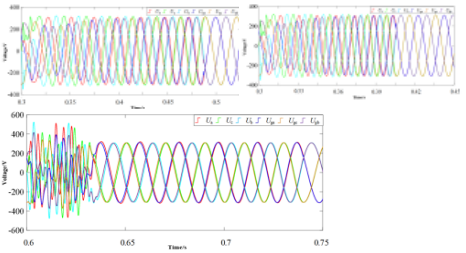
Grid-connected operation mode

- Case1(Fig.28 Output voltage contrast(traditional),Fig.29 Output voltage contrast(proposed)



• Grid-connected operation mode

- Case2(Fig.30 Contrast diagram of output voltage when system load fluctuates(traditional),
- Case3(Fig.32 Contrast diagram of output voltage(DG))



Conclusion

- Aiming at the limitations of traditional droop control, a control strategy for isolated and grid-connected operation modes of the microgrid is proposed.
- An improved droop control algorithm based on fuzzy logic is proposed for isolated operation mode. The droop resistance is adjusted by outputting the virtual compensating resistance of the fuzzy logic controller. Hence, the droop curve is improved and the current sharing accuracy and voltage regulation ability of the system are improved.
- A pre-synchronization control algorithm based on CMAC and traditional PID compound adaptive control algorithm is proposed for grid-connected operation mode. The output voltage of the grid-connected inverter can track the voltage of the main network quickly and accurately. Besides, the safe switch of the microgrid from island mode to grid-connected mode could be realized. Simulation results verify the effectiveness of the proposed algorithm.