

# ICIEA 2022

16 - 19 Dec 22  
Chengdu, China

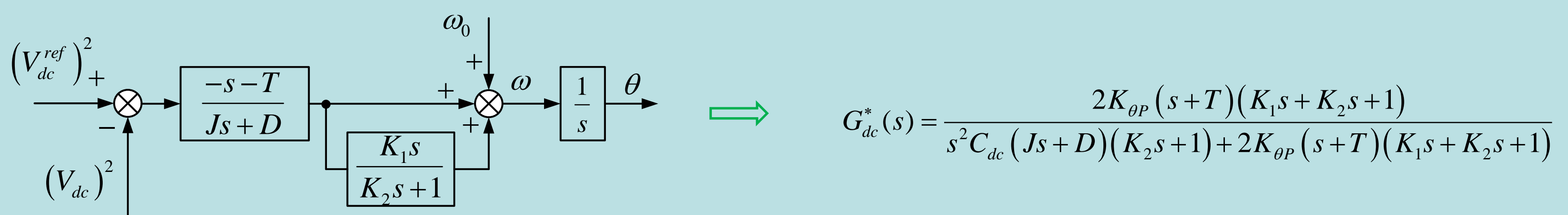
ICIEA22-000074

## Improved Control Strategy for Grid-connected Converters Based on PLL-free Control

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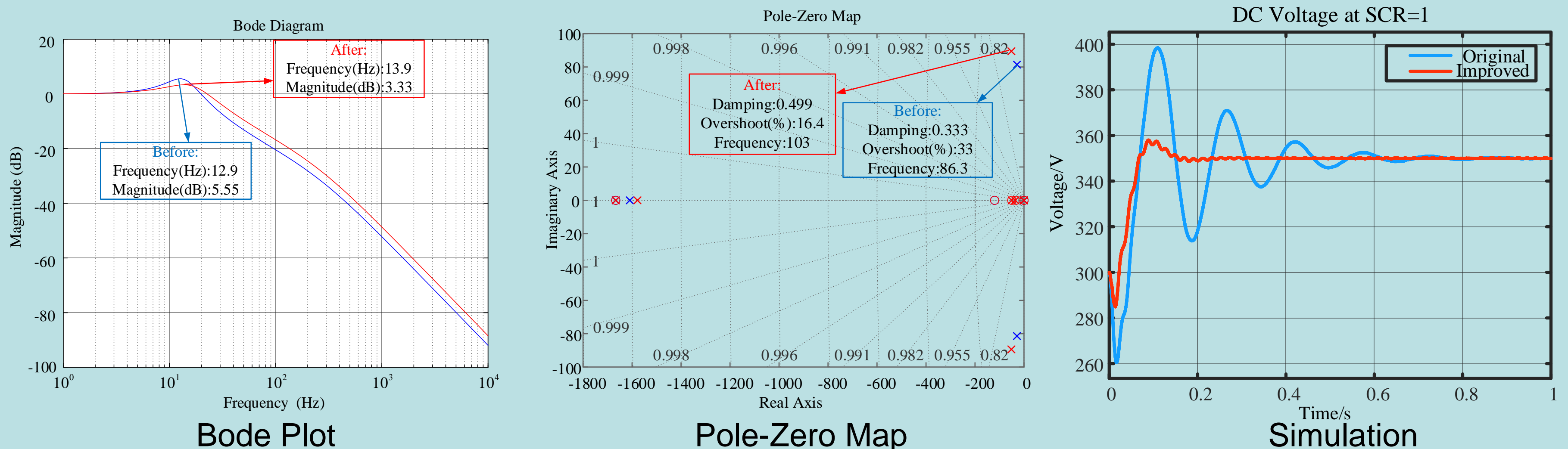
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With the increase of renewable energy penetration, the ability of grid-connected converters to operate under weak grid conditions has gradually become a challenge. Under weak grid conditions, due to the instability of grid voltage, the coupling between phase-locked loop (PLL) and grid impedance will affect the work of the converter or even become unstable. Aiming at the weak grid control method of grid-side converters, this paper uses the inherent dynamic characteristics of DC voltage to realize voltage-controlled autonomous synchronous control, instead of the traditional PLL control strategy, and adopts a control structure without inner loop. The improvement of DC voltage stabilization control is proposed, and the dynamic response process of DC voltage is optimized.



Improved DC Voltage Stabilization Control Diagram

### Analysis and Simulation



After the improvement, the bandwidth of the system Bode plot increases, and the peak amplitude decreases from 5.55dB to 3.33dB, the dominant pole is far away from the real and imaginary axes, the damping value is increased from 0.333 to 0.499, the overshoot is reduced from 33% to 16.4%, and the oscillation frequency is increased from 86.3Hz to 103Hz. As the simulation result shows, the overshoot of the DC voltage control dynamic process is reduced, the adjustment time is reduced, and the system has a better dynamic process.

### Summary

- 1) Select the appropriate K1 and K2 parameters, the damping of the DC voltage control is increased from 0.333 to 0.499, the overshoot is reduced from 5.5dB to 3.3dB, the bandwidth is increased, and the rapidity is improved.
- 2) Under the condition of weak grid, although the parameter T can be reduced to reduce the overshoot in the process of DC voltage establishment before the improvement, the stability margin of the system decreases with the decrease of T. After the improvement, without changing the original parameters, the overshoot during the DC voltage establishment process is well suppressed, the bandwidth is increased, and the rapidity is increased. The improved control strategy improves the weak grid operation capability of the system.