# The Virtual Admittance Control of Sending End Converter for Offshore Wind Farm Integration

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## Introduction

- To integrate and transfer bulk ***offshore wind power*** to the onshore grid, the ***voltage source converter-based high voltage direct current (VSC-HVDC)*** transmission system is becoming a promising scheme.

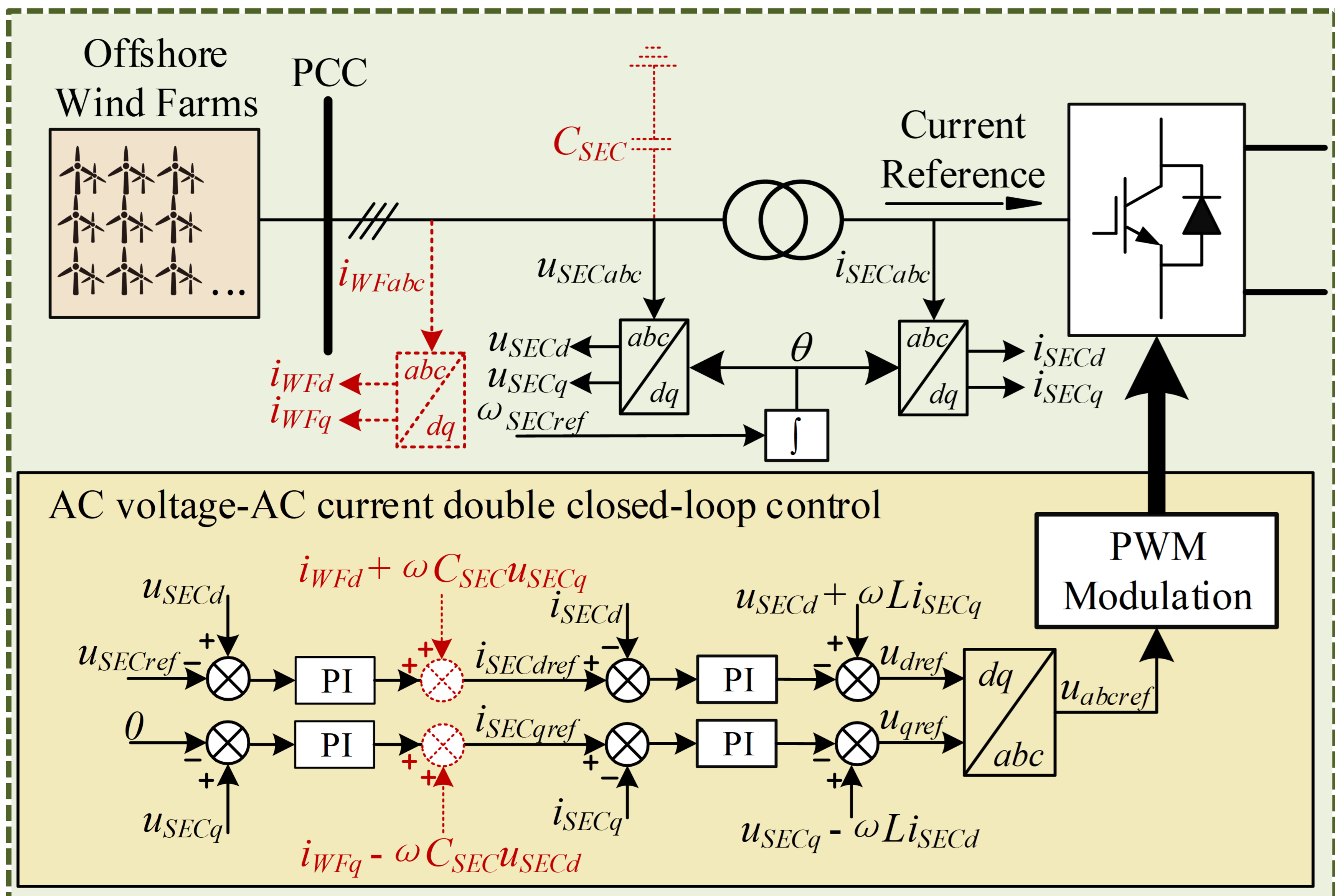
Isolated Island Operation | Low Overcurrent Capability

***Dual closed-loop control*** is widely utilized in the SEC

Designed for ***the 2-level converter*** with ***the filter capacitor***

Commonly used Modular Multilevel Converter (MMC)

## Conventional Dual Closed-Loop Control Scheme



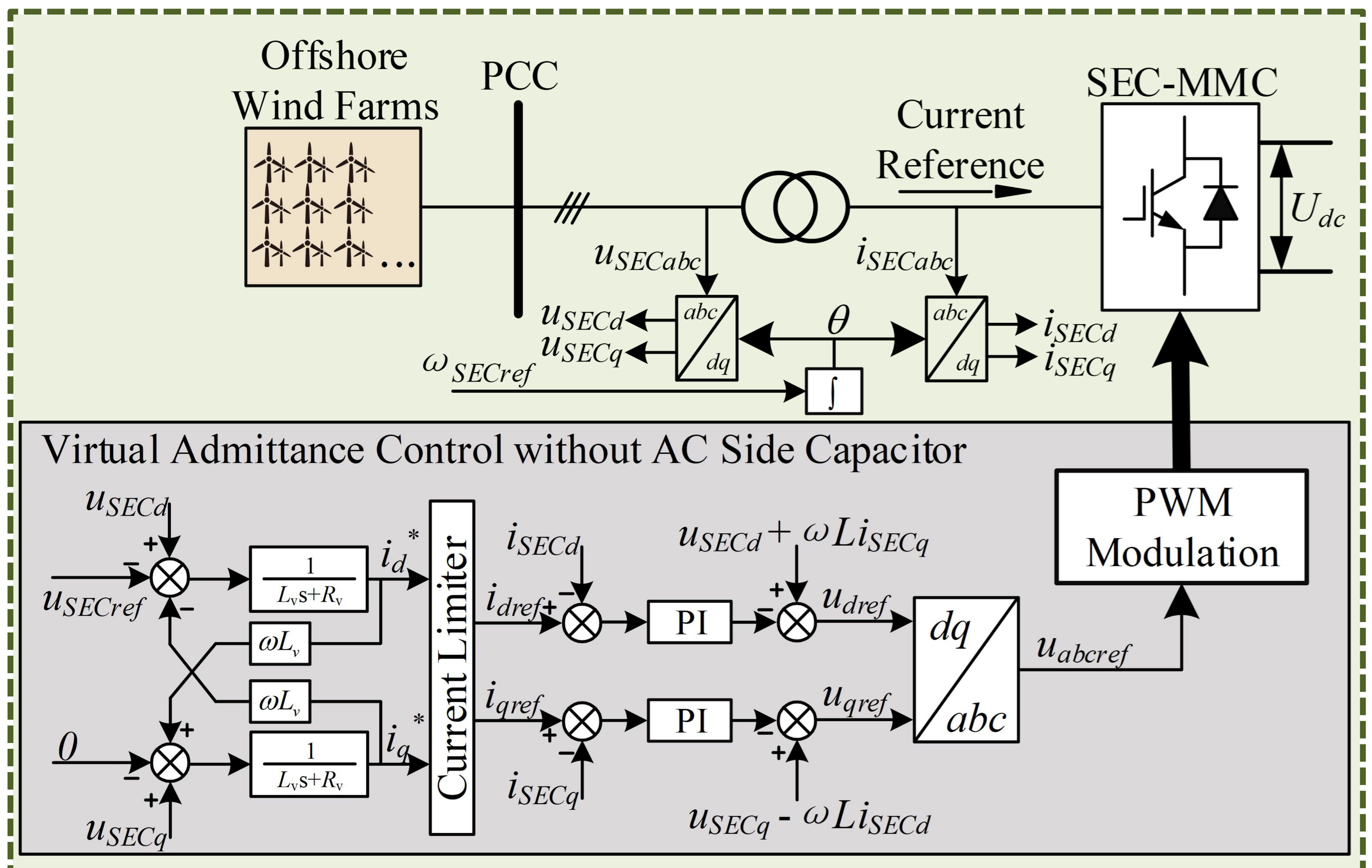

MMC → without AC capacitor

The feedforward of the load current
The decoupling terms
→ **Absence**

**Worsened Control Performance**

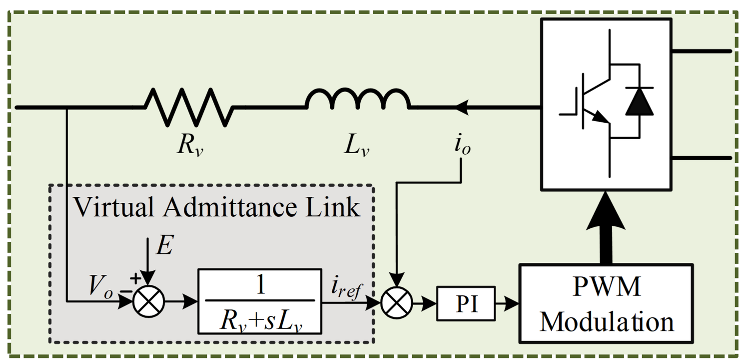
**The transient overcurrent capacity is poor**

## Virtual Admittance Control of SEC




$$i_{dref} = \begin{cases} i_d^* & \sqrt{i_d^{*2} + i_q^{*2}} < i_{\lim} \\ \dfrac{i_{\lim}}{\sqrt{i_d^{*2} + i_q^{*2}}} i_d^* & \sqrt{i_d^{*2} + i_q^{*2}} \ge i_{\lim} \end{cases}$$

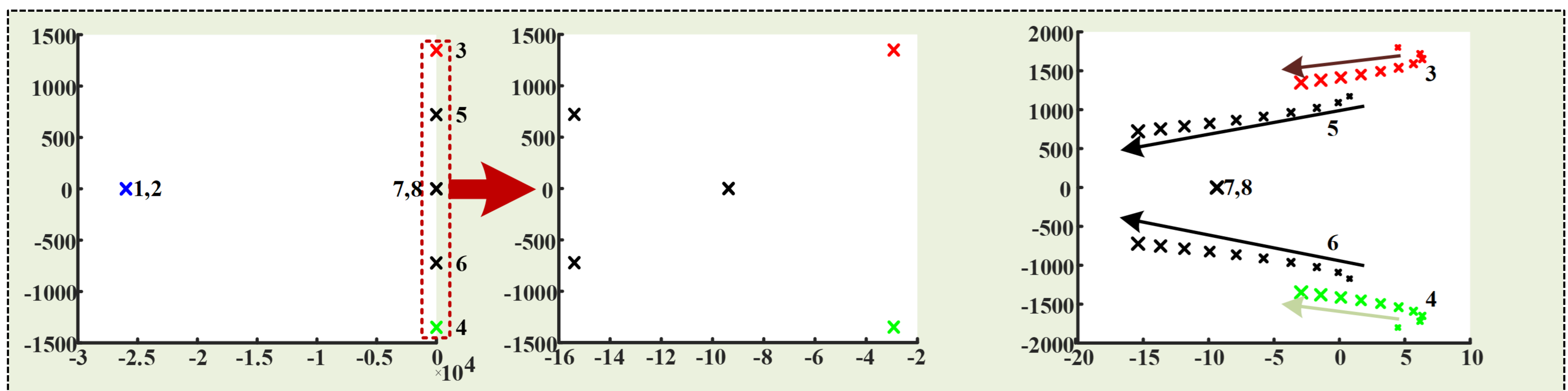
Elliptic Current limiter



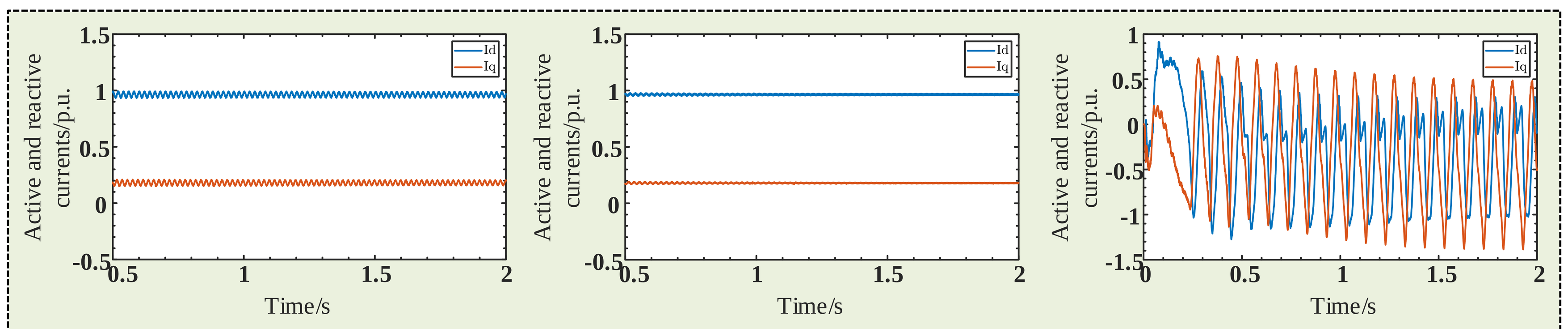

Control Principle

## Parameter Design

$\Delta \dot{x} = A\Delta x + B\Delta u$ » State space matrix A » Eigenvalues analysis

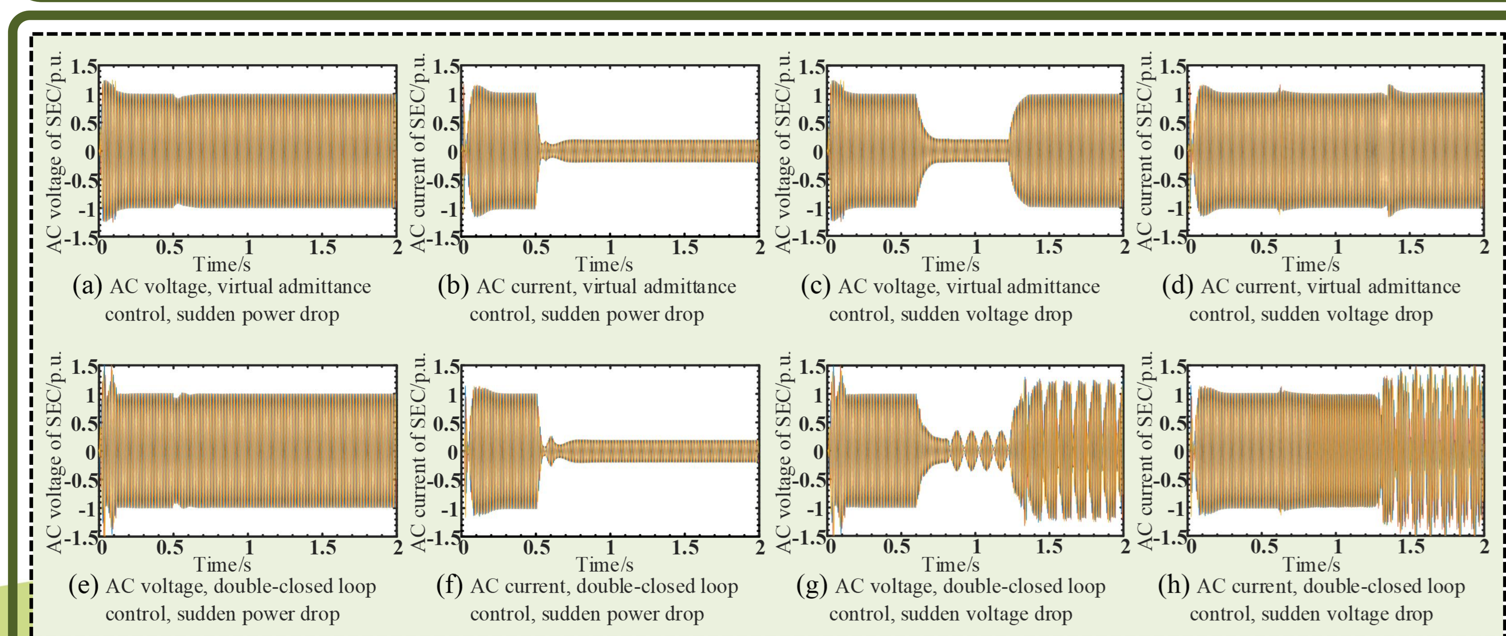


(a) Eigenvalues distribution of SEC based on virtual admittance control (b) Root locus based on virtual admittance strategy



(a) $L_v$=0.03, $R_v$=0.01 (b) $L_v$=0.3, $R_v$=0.1 (c) $L_v$=3, $R_v$=1

## Result and Conclusion



(a) AC voltage, virtual admittance control, sudden power drop (b) AC current, virtual admittance control, sudden power drop (c) AC voltage, virtual admittance control, sudden voltage drop (d) AC current, virtual admittance control, sudden voltage drop (e) AC voltage, double-closed loop control, sudden power drop (f) AC current, double-closed loop control, sudden power drop (g) AC voltage, double-closed loop control, sudden voltage drop (h) AC current, double-closed loop control, sudden voltage drop

- The virtual admittance control strategy has better ***steady-state performance***.
- Under the condition of a sudden drop in wind farm power: 1. ***More quickly without oscillation***; 2. ***Transient voltage peak of 1.25p.u.*** (much smaller).
- Under the condition of active voltage drop of SEC: 1. ***Avoid the problems of losing feedforward and decoupling terms***; 2. ***Saturation*** of the outer loop.
- Parameter design: $L_v$ and $R_v$ : 1. ↓ ***(Unstable, RHP)***; 2. ↑ ***(Reduces the active power transmission limit)*** .