

Ling Xu<sup>1</sup>, Zhixin Miao<sup>1</sup>, Lingling Fan<sup>1</sup>

Department of Electrical Engineering, University of South Florida, 4202 E. Fowler Ave. Tampa FL 33620

## Motivation

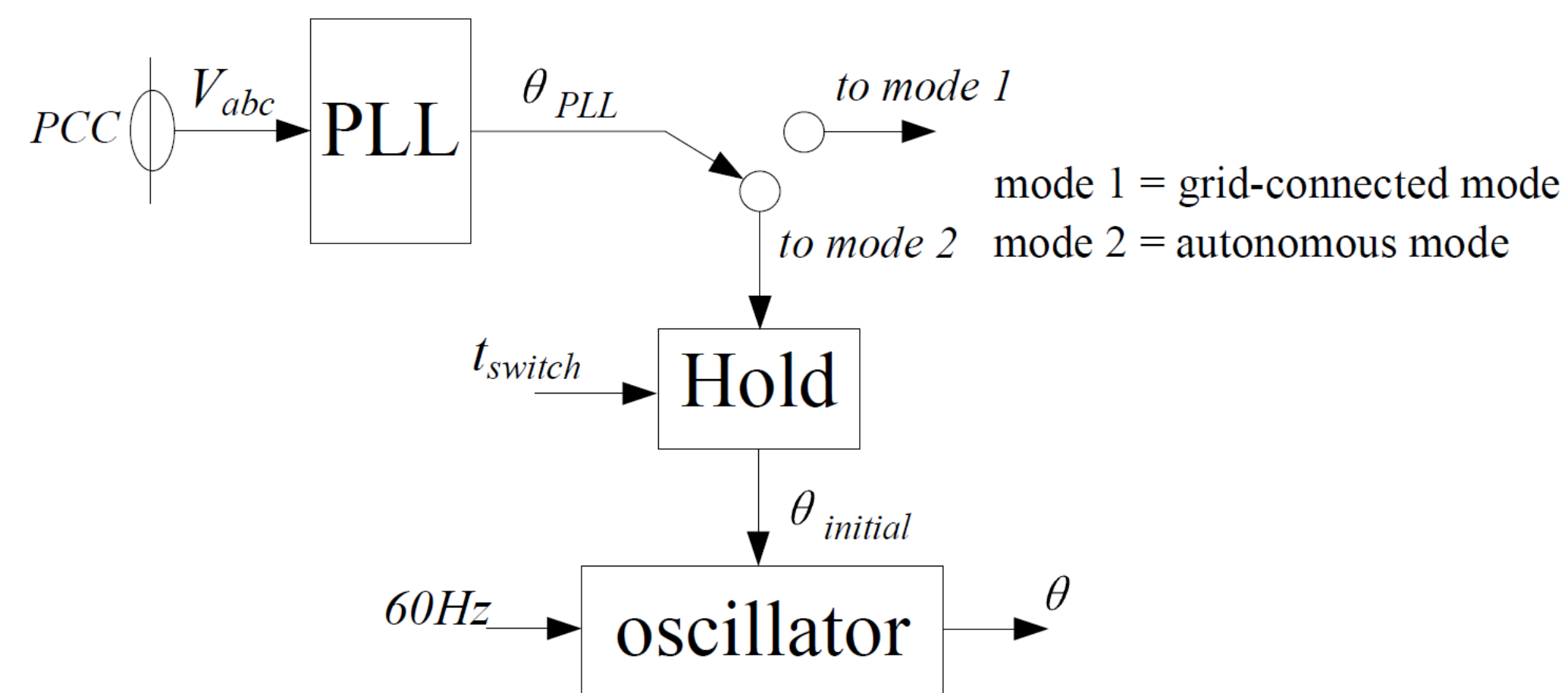
Microgrids with VSC systems can operate in both grid-connected and islanded modes. If an islanded event occurs, the VSC system could switch to support the PCC voltage and the frequency. However, the initial phase of the VSC output voltage after islanded event is critical for the performance of the microgrid and the VSC system.

## Approach

A control system for a back-to-back VSC system is proposed which is able to work both on grid-connected and islanded modes. The control scheme of grid-connected mode is designed based on existing method.

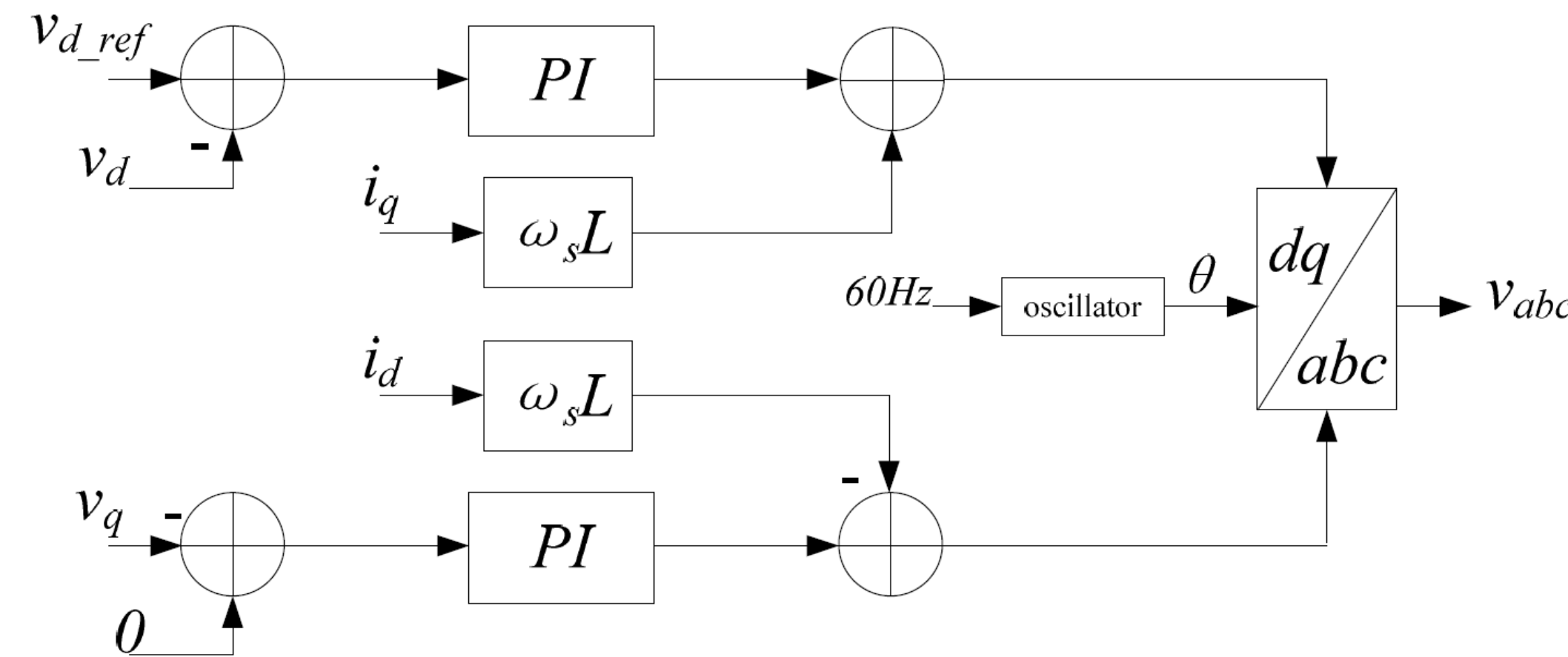
The Islanded mode control system consists of two parts:

### Initial phase control



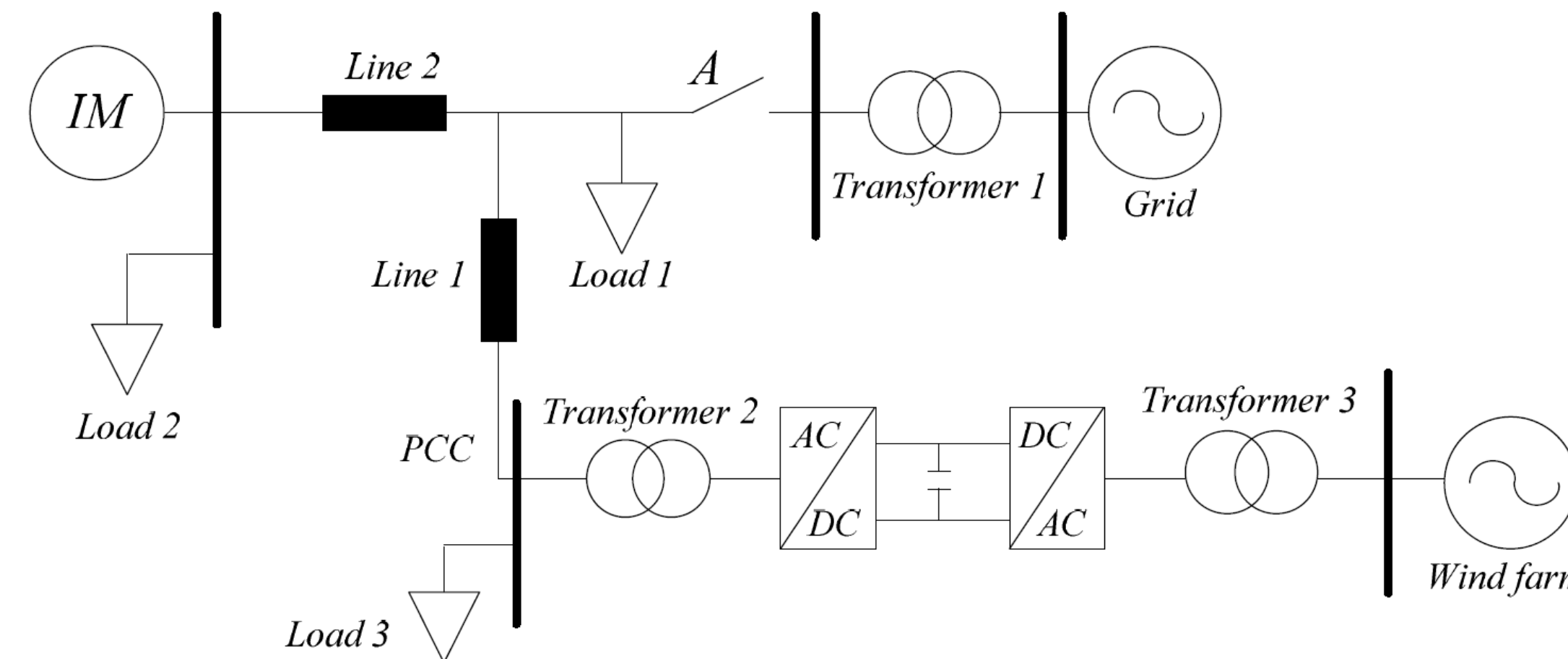
- ❖ Grid connected: phase is tracked by PLL
- ❖ Islanded: phase is generated by an oscillator, and the initial value is equal to the value before the islanded event occurred

### PCC voltage & frequency control



## Test system

A microgrid is built in PSCAD/EMTDC to evaluate the proposed control system. It consists of



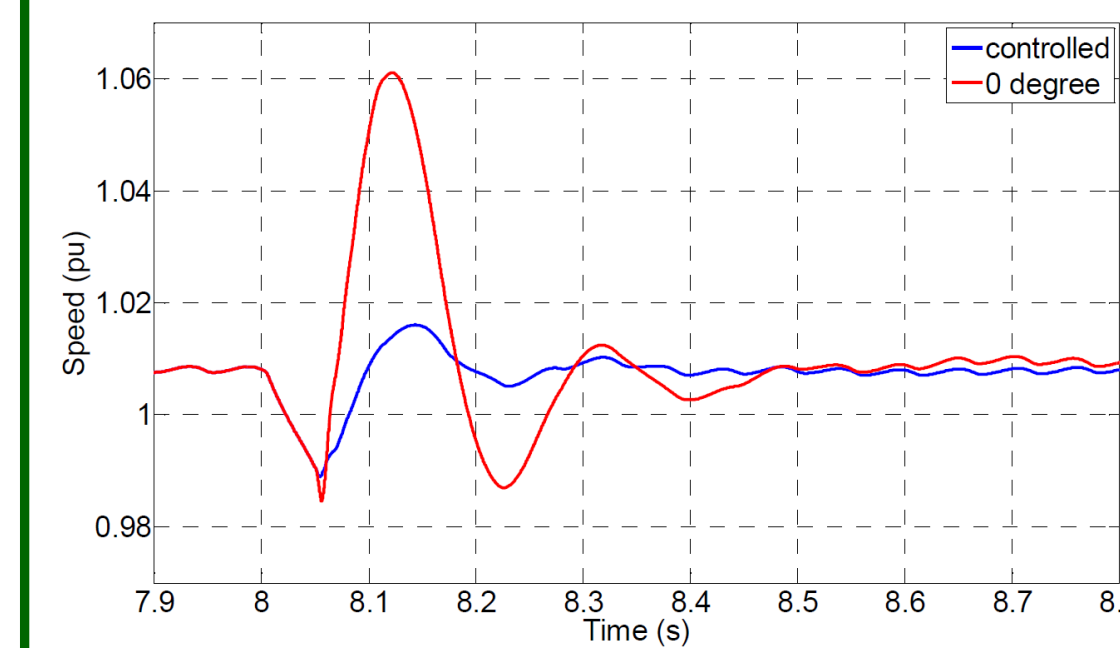
- Back-to-Back VSC
- A wind farm
- Three passive loads
- An induction machine operating as a generator

## Simulation results

Simulation of proposed control system is implemented in PSCAD/EMTDC. The influences of the control system (with and without the initial phase control) on the induction machine (IM) are compared.

Case study event sequence

- The microgrid operates at grid-connected mode.
- An islanded event detected at 8 sec.

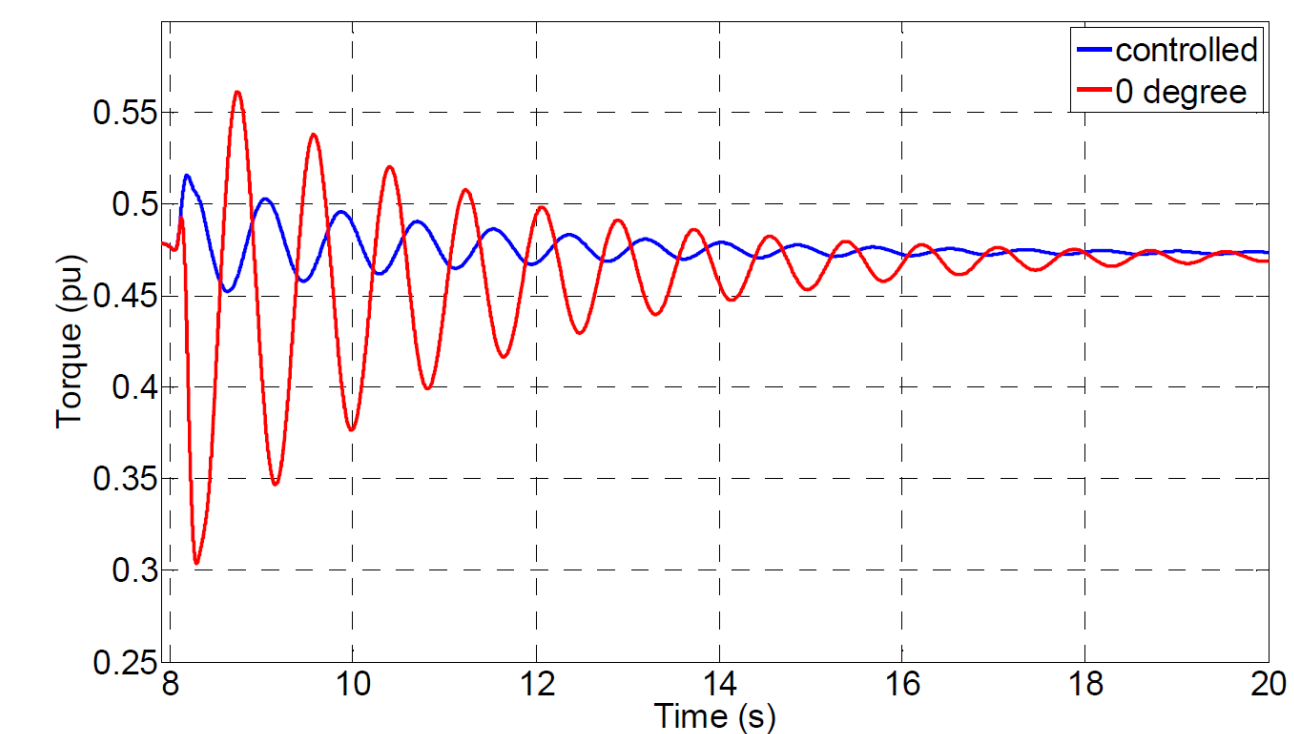


IM speed

- High speed deviation – without initial phase control
- Smooth transition – with initial phase control

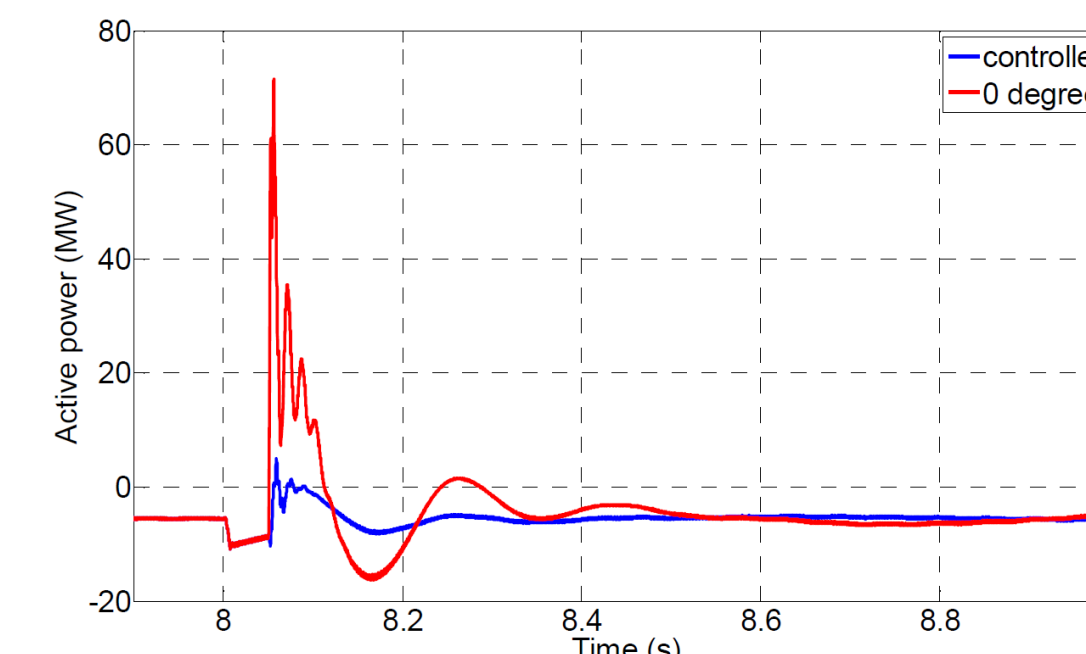
IM torque

- Greater and longer oscillation – without initial phase control
- Smaller and shorter oscillation – with initial phase control



IM active power output

- Greater spike – without initial phase control
- Smaller spike – with initial phase control



IM reactive power output

- Great spike – without initial phase control
- Smaller spike – with initial phase control

