Camilo Garzón, Shrinath Kannan, Ana María Blanco, Miguel Romero, Jan Meyer, Andrés Pavas

Power Quality in AC Islanded Microgrids

Mitigation and Commonly Used Control Strategies

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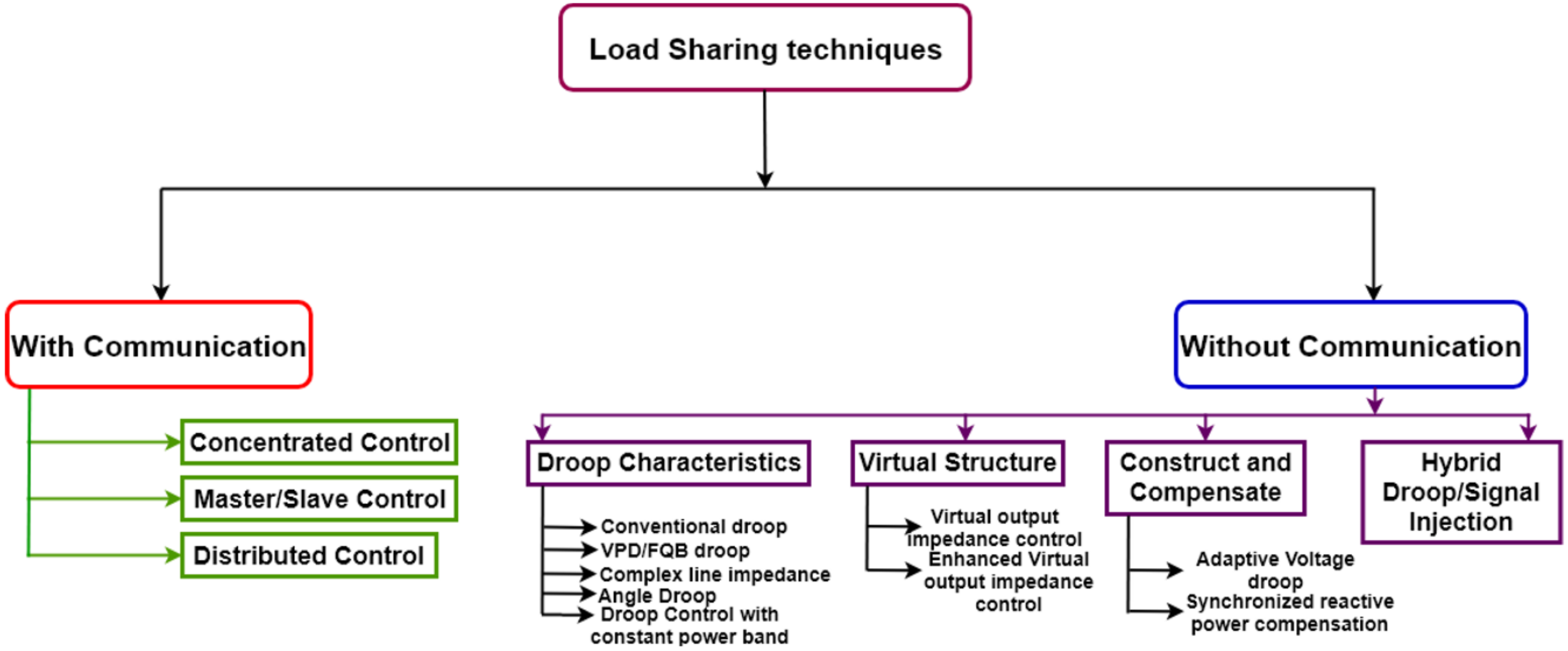
Content

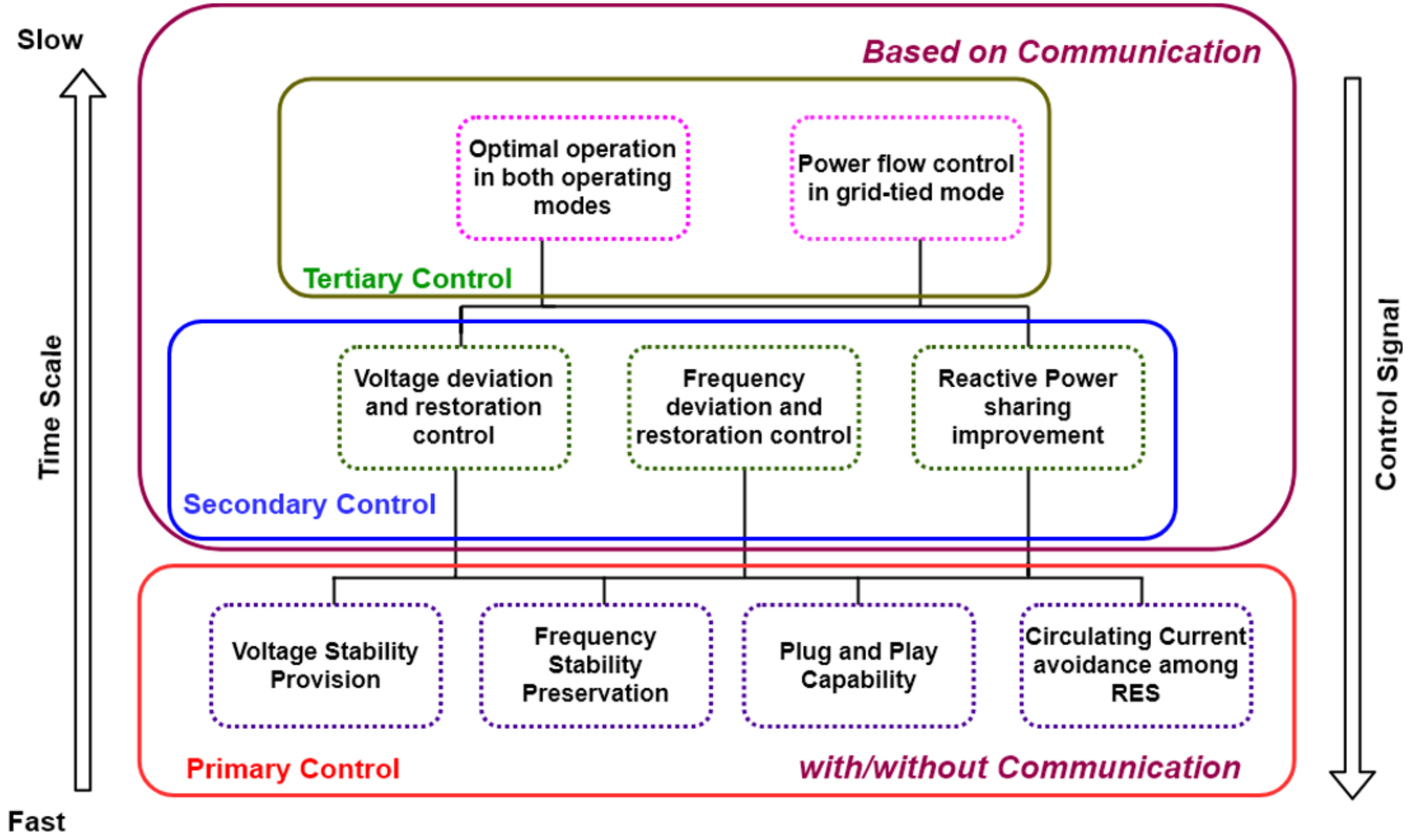
Control Strategies for Power Quality Enhancement in Islanded Microgrids

1. Ensure successful operation by supplying the power demand for **various kind of load**.
2. Ensure **ideal** operating conditions in terms of power quality.



Control Strategies for Power Quality Enhancement in Islanded Microgrids

Control Technique for Unbalance and Harmonic Mitigation



[4] Review of Active and Reactive Power Sharing Strategies in Hierarchical Controlled Microgrids.

[5] Tertiary Control of Voltage Unbalance Compensation for Optimal Power Quality in Islanded Microgrids

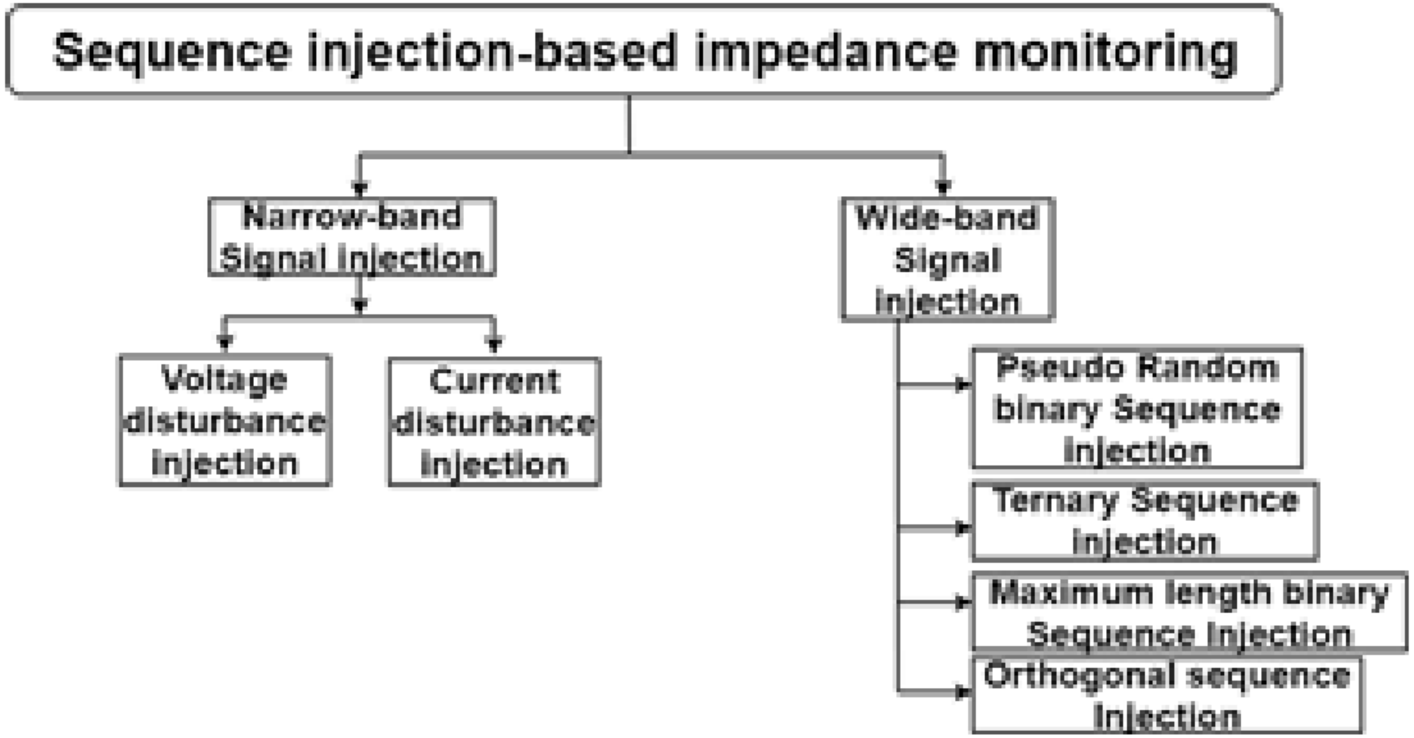
[6] Voltage unbalance and harmonic compensation in microgrids by cooperation of distributed generators and active power filters.

[7] Real-Time Supervisory Control for Power Quality Improvement of Multi-Area Microgrids.

[3] Review of Power Sharing Control Strategies for Islanding Operation of AC Microgrids.

Control Strategies for Power Quality Enhancement in Islanded Microgrids

Techniques for Harmonic Impedance Monitoring



[8] Harmonic Stability in Power Electronic-Based Power Systems: Concept, Modeling, and Analysis.

[9] Noninvasive Online Parametric Identification of Three- Phase AC Power Impedances to Assess the Stability of Grid-Tied Power Electronic Inverters in LV Networks.

[13] Measurement of network harmonic impedance in presence of electronic equipment.

Standalone Devices for Power Quality Improvement in Islanded Microgrids

Device	Acronym	Purpose	Principle	Main Components
Distributed Static Synchronous Compensator	STATCOM	Improve transient stability	Supply/Demand AC reactive power	Capacitor and power electronic-based source
Dynamic Voltage Restoration	DVR	Overcoming voltage sags and swells	Inject voltage	Capacitor and power electronic AC/DC inverters
Active Power Filter	APF	Harmonic attenuation	Inject active power	Power electronics based source
Static VAR Compensator	SVC	Improve transient stability and harmonic attenuation	Demand reactive power and current harmonics.	Reactors and power electronic-based switch
Universal Power Quality Conditioner	UPQC	Compensate power quality disturbances	Supply/Demand AC reactive power and current harmonics	Capacitor and power electronic-based source

Common Methods:

1. Sequence current components as reference.
2. Harmonic current injection
3. Virtual impedance

Advantages:

1. Flexibility
2. Reliability
3. Power quality improvement
4. Reduce harmonic emissions from DG's
5. Losses reduction in lines
6. Allow to compensate harmonics and unbalance

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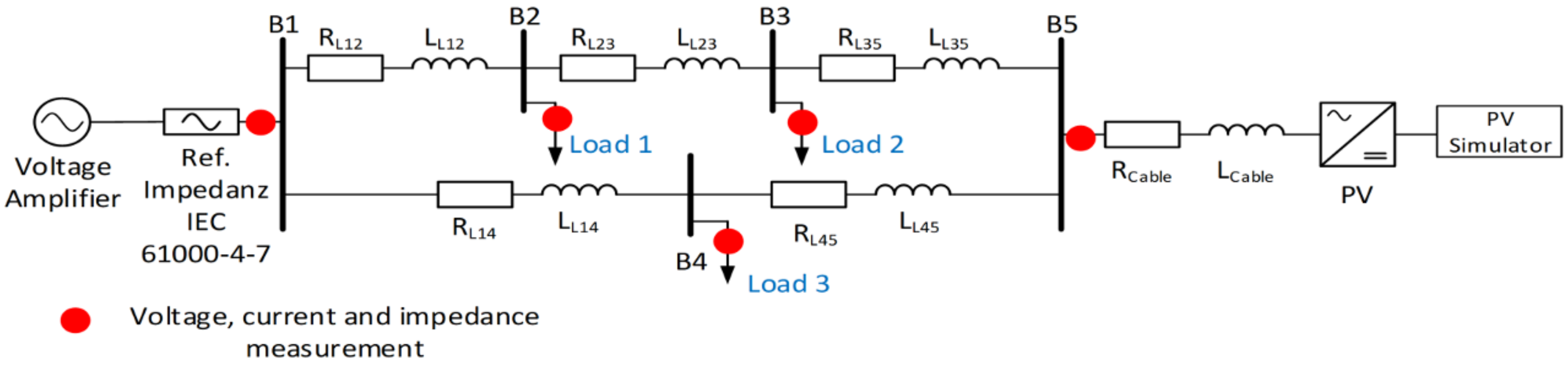
Issues:

1. High operation cost
2. Optimum location
   1. Performance of the compensator can be affected by grid conditions like DG location or R/X ratio of lines
   2. Improvement at the location of the DG, but gets worse at other sites
   3. Impact no well defined
3. Sizing
4. Control

Standalone Devices for Power Quality Improvement in Islanded Microgrids

Measurement and Monitoring Issues Related to Microgrids



1. Power quality monitoring standards: IEC 61000-4-7 and IEC 61000-4-30

2. Amount of information and the required calculation algorithms imply high computational requirements.
    2.1 Monte Carlo simulation to extract random samples from the 200ms time window

3. Higher amount of monitored locations and distributed power quality monitoring systems in MGs

4. Many systems are not capable of processing and sending real-time data.

Conclusions

- A comprehensive design approach of control strategies to mitigate typical power quality issues and resonances can significantly contribute to a reliable (ideal) operation of MGs under all scenarios.
- MGs tend to need higher visibility of the network and consequently denser monitoring.
- Not only the connected loads but also the electronic-based power sources can cause power quality disturbances in islanded MGs.
- There is certain evidence that just taking over the EMC coordination (compatibility levels, emission limits, immunity limits) from traditional (interconnected) grids is not suitable and optimal for islanded MGs.

Thank you for your attention

Contact:
Camilo Garzón
Research Assistant

Universidad Nacional de Colombia
Programa de Adquisición y Análisis de Señales Electromagnéticas (PAAS-UN)
Email: cagarzon@unal.edu.co