An Approach to Control Photovoltaic Generator to Damp Low Frequency Oscillations in Emerging Distribution Systems

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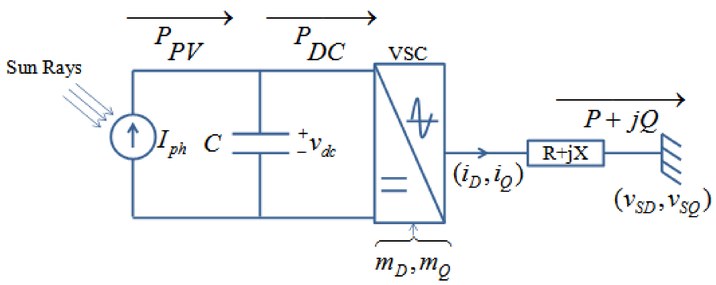
Motivations

- Increasing penetration of DG units in distribution networks.
- Negative interactions among DG units and their controllers.
- Emergence of low damped and low frequency oscillations.
- Necessity of a suitable control methodology to ensure small signal stability.

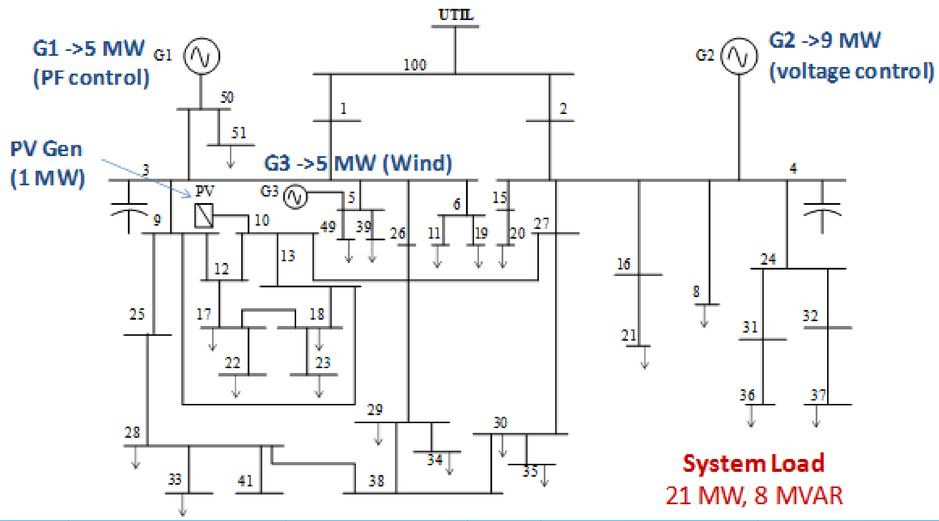
Photovoltaic Model



DC link dynamics $\frac{C}{2}\frac{dv_{dc}^2}{dt} = P_{PV} - P_{DC}$

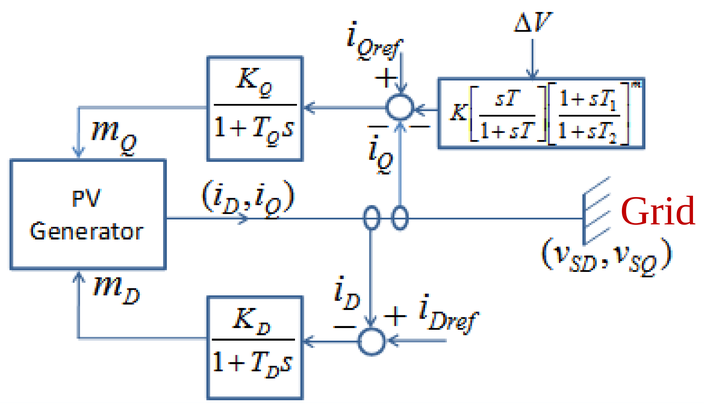
Output powers $\begin{cases} P = \frac{3}{2}\left(v_{SD} i_D + v_{SQ} i_Q\right) \\ Q = \frac{3}{2}\left(v_{SQ} i_D - v_{SD} i_Q\right) \end{cases}$

Test Distribution System

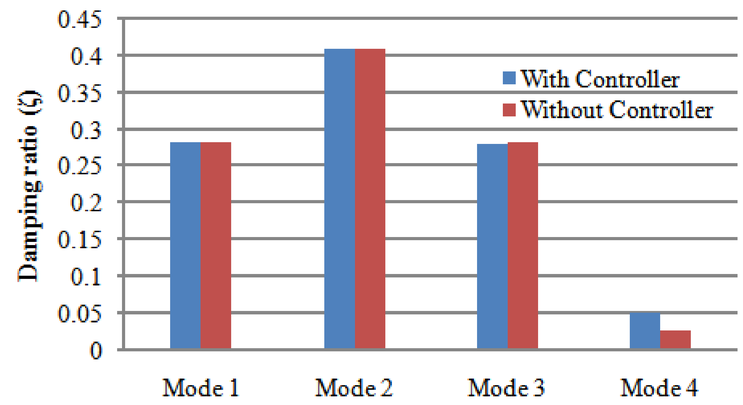


Mode	Damping ratio (%)	Frequency (Hz)	Mode	Damping ratio (%)	Frequency (Hz)
1	28.3	4.2	3	41	3.4
2	28.2	3.2	4	2.74	0.9

PV Control Approach



Effectiveness of Controller



Conclusions

- Negative interactions can generate low damped mode in emerging distribution systems.
- PV can be controlled to enhance damping of critical mode, while keeping other modes unaffected.
- Future work will focus on coordinated control of different DG units in a distribution network.