Object Linking and Embedding for Process Control in Power System Analysis

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Introduction

- Object linking and embedding for Process Control → the means to model a smart grid
- Voltage regulation on distribution systems - a new challenge as distributed generation increases
- Fixed inductive power factor unsuitable for all conditions
- Automatic voltage regulation at generation location doubly burdens conductors
- Are HV/MV transformers inhibiting the generation from DG units?

Objective:

➢ **To investigate the pseudo-coordinated control of distributed generation and existing power system assets.**

Methodology

- OPC Tool developed to interface online power flow simulations with control strategies

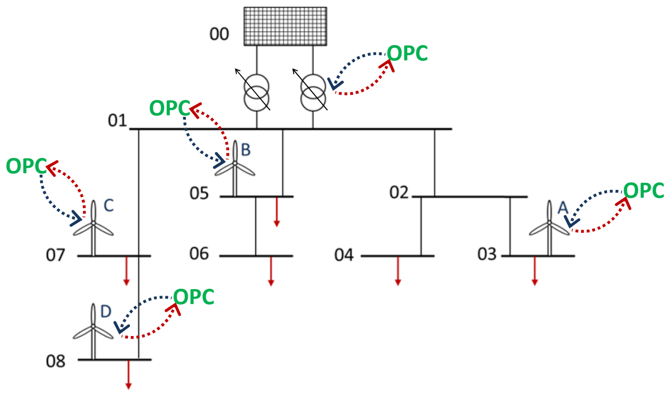
- Role of the on-load tap changer to regulate secondary voltage by adjusting the turns ratio
- Lowering the target voltage would permit more generation on distribution networks
- Novel transformer control logic implemented

$$r_{k+1} = \begin{cases} r_k + \Delta r & if\ \ Q > Q^+ \ or\ V > V^+,\ and\ \ r < r_{max} \\ r_k - \Delta r & if\ \ Q < Q^- \ or\ V < V^-,\ and\ \ r_k > r_{min} \\ r_k & otherwise \end{cases}$$

- Complex power flow through the transformer an indicator for a change in tap position
- Lower voltage at times of high generation, when the risk of voltage rise is most apparent
- Higher voltage at times of low generation to best maintain an acceptable voltage at the end of the distribution feeder

Test Network

- Section of Irish 38 kV distribution system fed from 63 MVA transformer
- Type IV wind farms modelled generating 30 second resolution historic data



Results

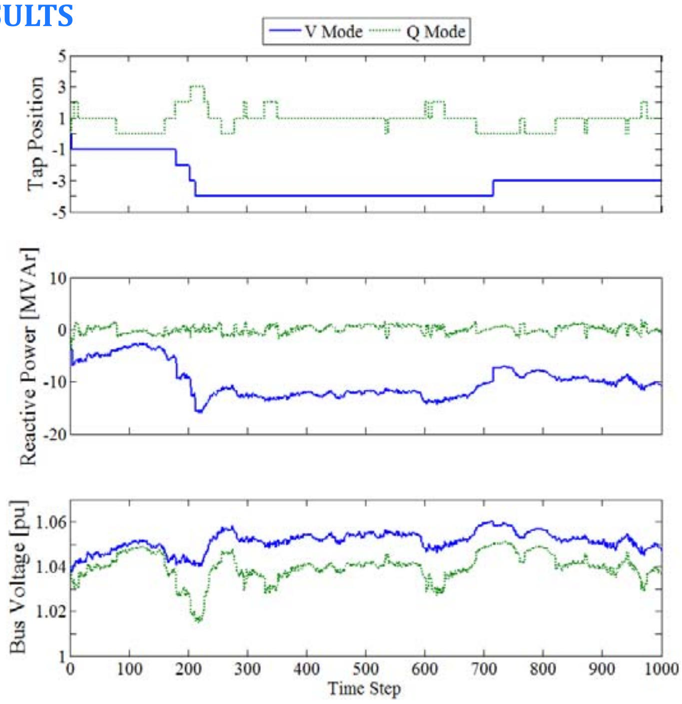


Fig. 1 Comparison of tap position, reactive power flow and voltage magnitude with time

Table I
Comparison of Active Power Losses [MWh]

Line	V Mode [MWh]	Q Mode [MWh]	Decrease %
0102	1.06	0.75	29.02
0102	0.27	0.22	16.50
0107	0.64	0.36	43.07
0203	0.91	0.69	23.89
0204	0.00	0.00	-0.90
0506	0.12	0.09	24.85
0607	0.32	0.31	2.28
0708	0.12	0.12	-0.01

Conclusions

- **Enhance hosting capacity through better use of assets**
- **This and other control strategies under investigation**
- **Performance of control strategies can be compared against ideal AC optimal power flow solution**

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