

Power system services from DERs

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DERlab focus



Power system services

Power regulation

Voltage regulation

Short circuit power

Grid forming

DERlab focus

Active power control

- Frequency response

Reactive power control

- Voltage response

Tests

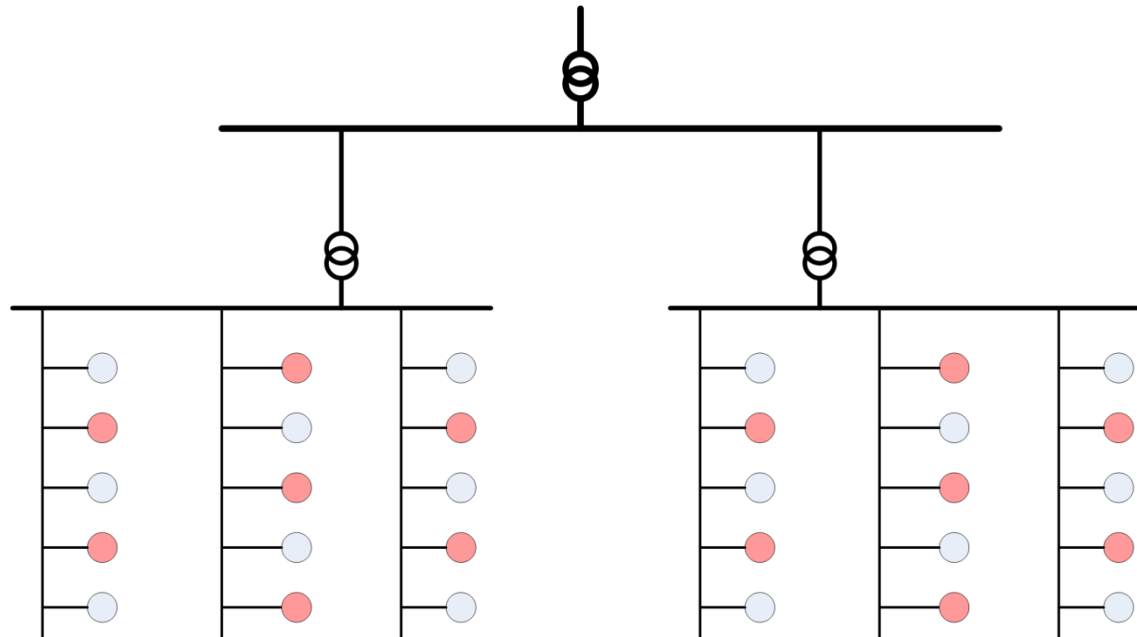
- Component level
- System level

Power regulation

Aggregated impact from many distributed units

Voltage regulation

Local impact from several units



Control

Regulation

Active power

Reactive power

Control

Broadcast / individual

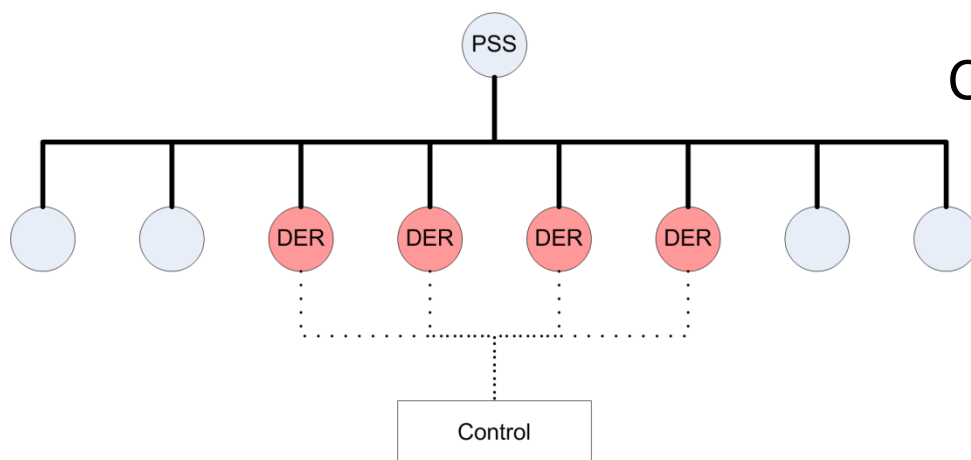
- one-way / two-way communication

Mandatory / voluntary

Centralised / distributed intelligence

Control signals:

- Price signal
- Frequency
- Voltage



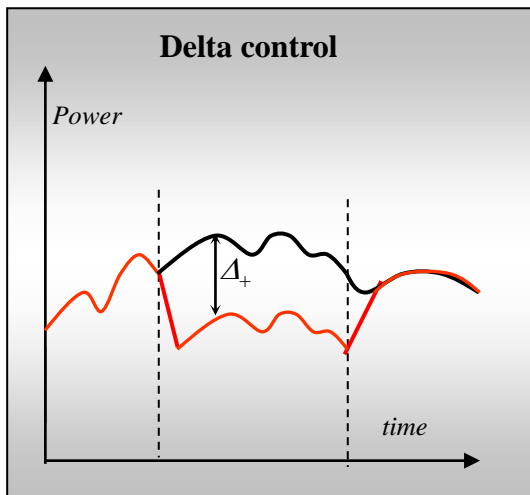
Power flexibility

Solar / wind power

Down-regulation

Delta-regulation

- Provide up-regulation



Demand response

All: Move load in time

Different nature:

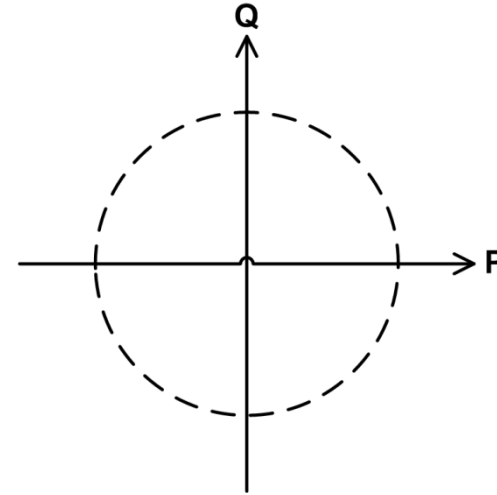
- Following a set-point
 - Temperature control
- Energy in a time window
 - EV charging

Reactive power

2 / 4 Q AC-DC inverters

Applications:

- PV inverter
- EV charger
- EV V2G



Test – component level

Test procedures dedicated for:

- Power producing units
- Power consuming units
- Bi-directional power units
 - Dedicated storage units
 - Combined units (e.g. EVs)

Test under controlled conditions:

- Response to external control signal
- Response to frequency
 - Mandatory response
- Response to voltage
 - Fault-ride-through capability

Test of:

- Response time
- Ramp rate
- Response level

Test – system level

Evaluation / test of aggregated power system services provided by many DER units

Relevant for

- Virtual power plants (VPP)
- Distribution system control
 - Power limits
 - Voltage
- Dynamic power prices

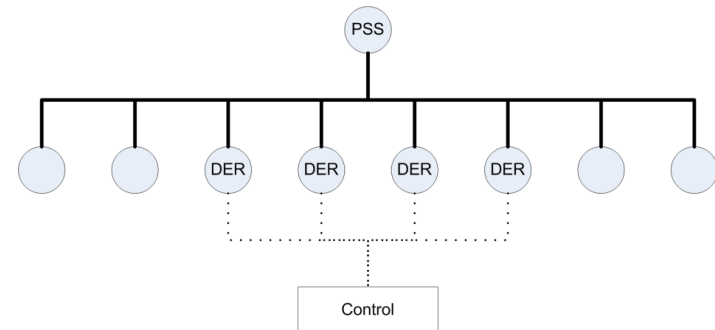
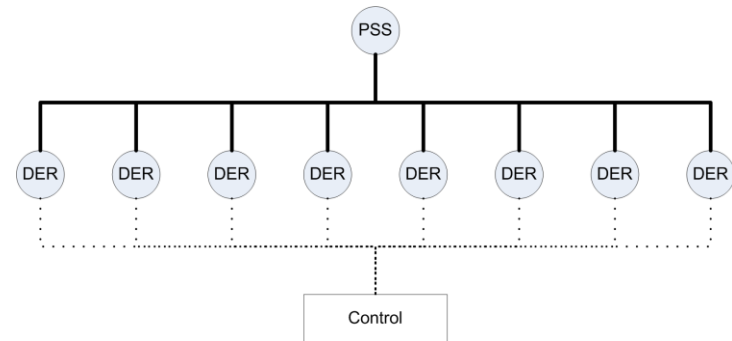
Metodologies

	Lab test	In situ test
Individual measurements	–	Simultaneous measurements
Aggregated measurement	X	Noise

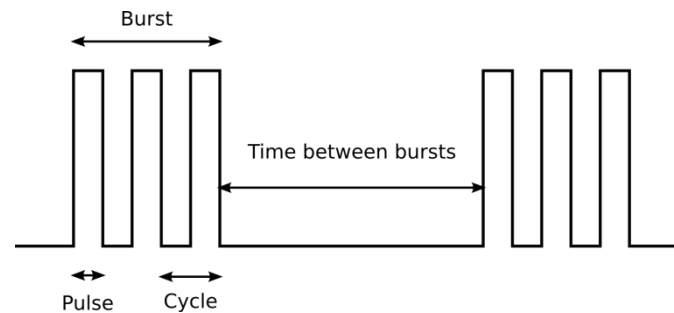
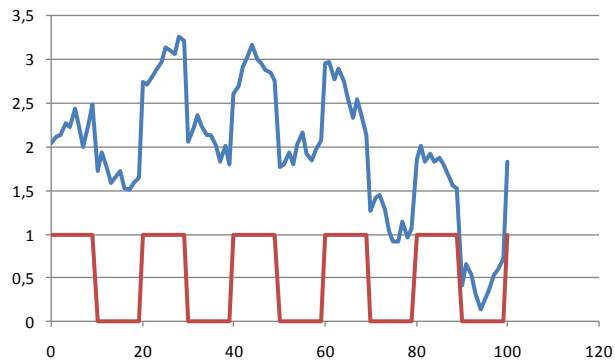
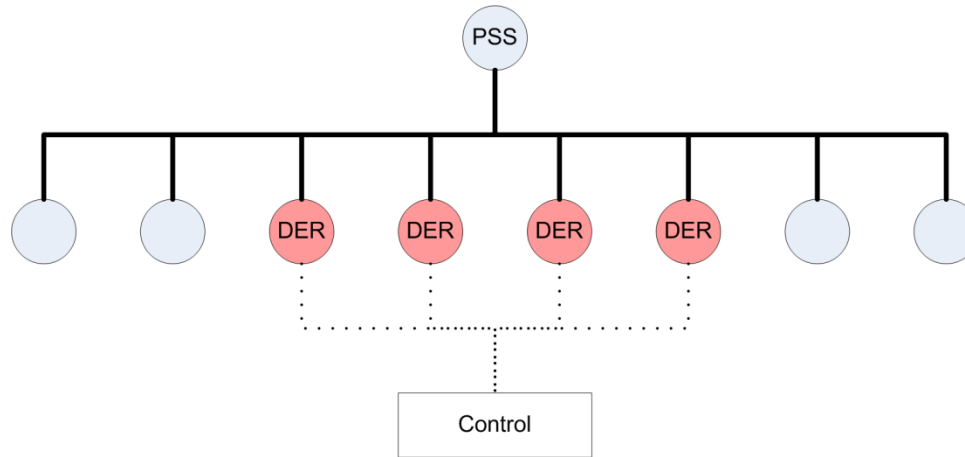
Lab-A: Ideal, but not practical

Situ-I: Costly and difficult

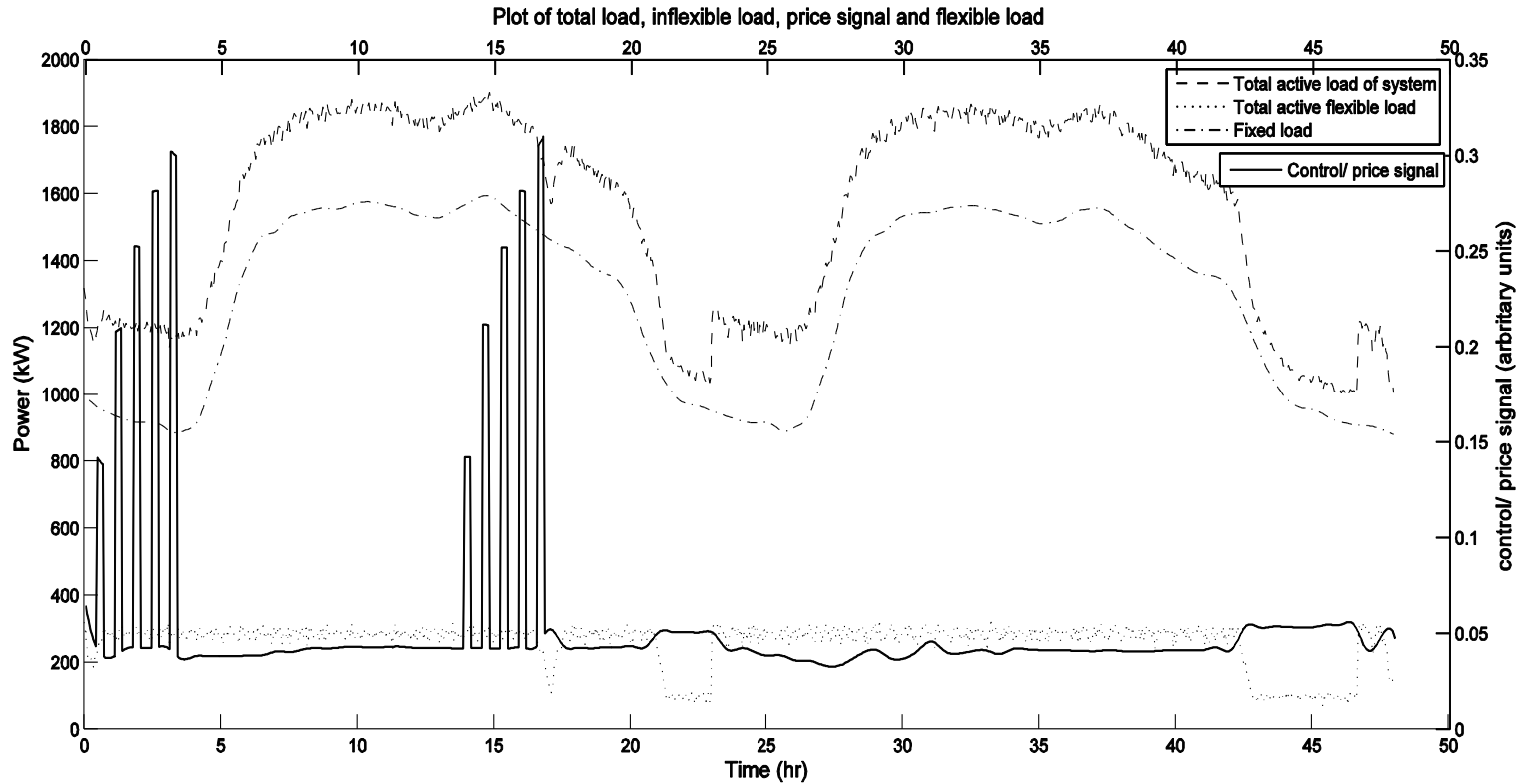
Situ-A: Simple, but not exact



Proposed test method



Simulation results



Conclusions

DER units may provide various power system services.

Focus in DERlab: Active and reactive power regulation.

Test at component level: rather straight forward.

Test at system level: new statistical method is proposed.

The proposed methodologies will be documented in a report.