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Grid-connected Converter with Voltage Support using only Local Measurements

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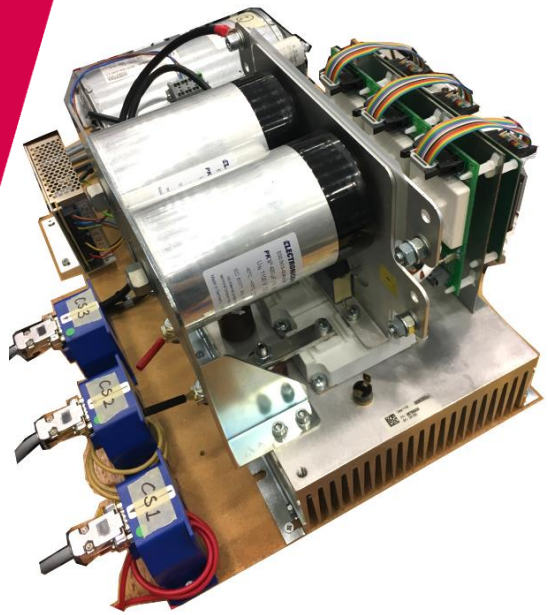


NWO Toegepaste en Technische Wetenschappen

TU/e Technische Universiteit Eindhoven University of Technology

Where innovation starts

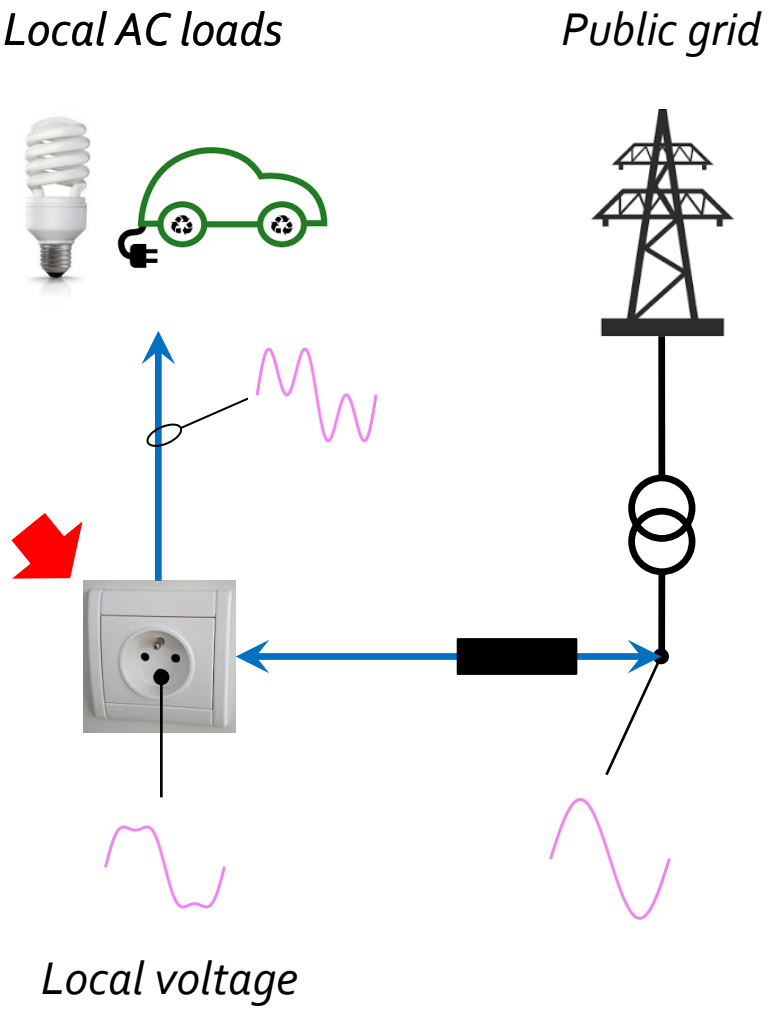
Outline

- Background: problems and solutions
- Proposal: upgrading control strategy
- Performance investigations:
  - Objective #1 – Harmonics compensation
  - Objective #2 – Active power transfer regulation
- Comparison between simulation & experiments
- Summary & Conclusions

Background(1/4): Harmonic problems

- Local non-linear loads
- Distorted grid current
- Cable impedance

➢ Distorted local voltage

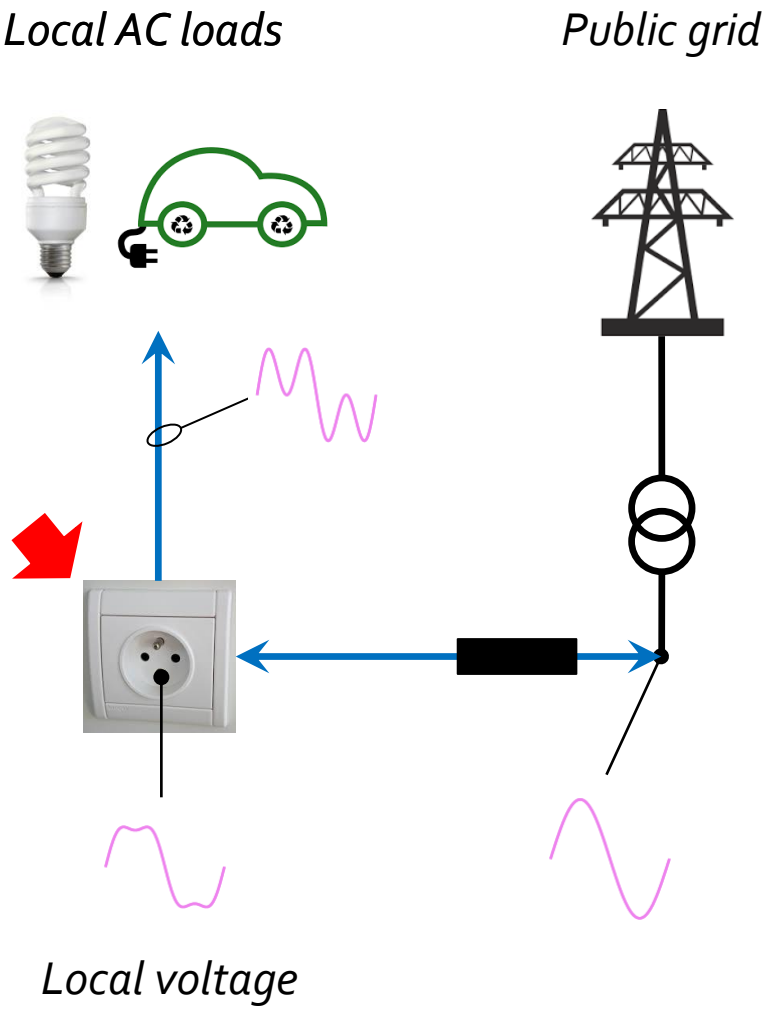


Background(2/4): Harmonic problems

- Local non-linear loads
- Distorted grid current
- Cable impedance

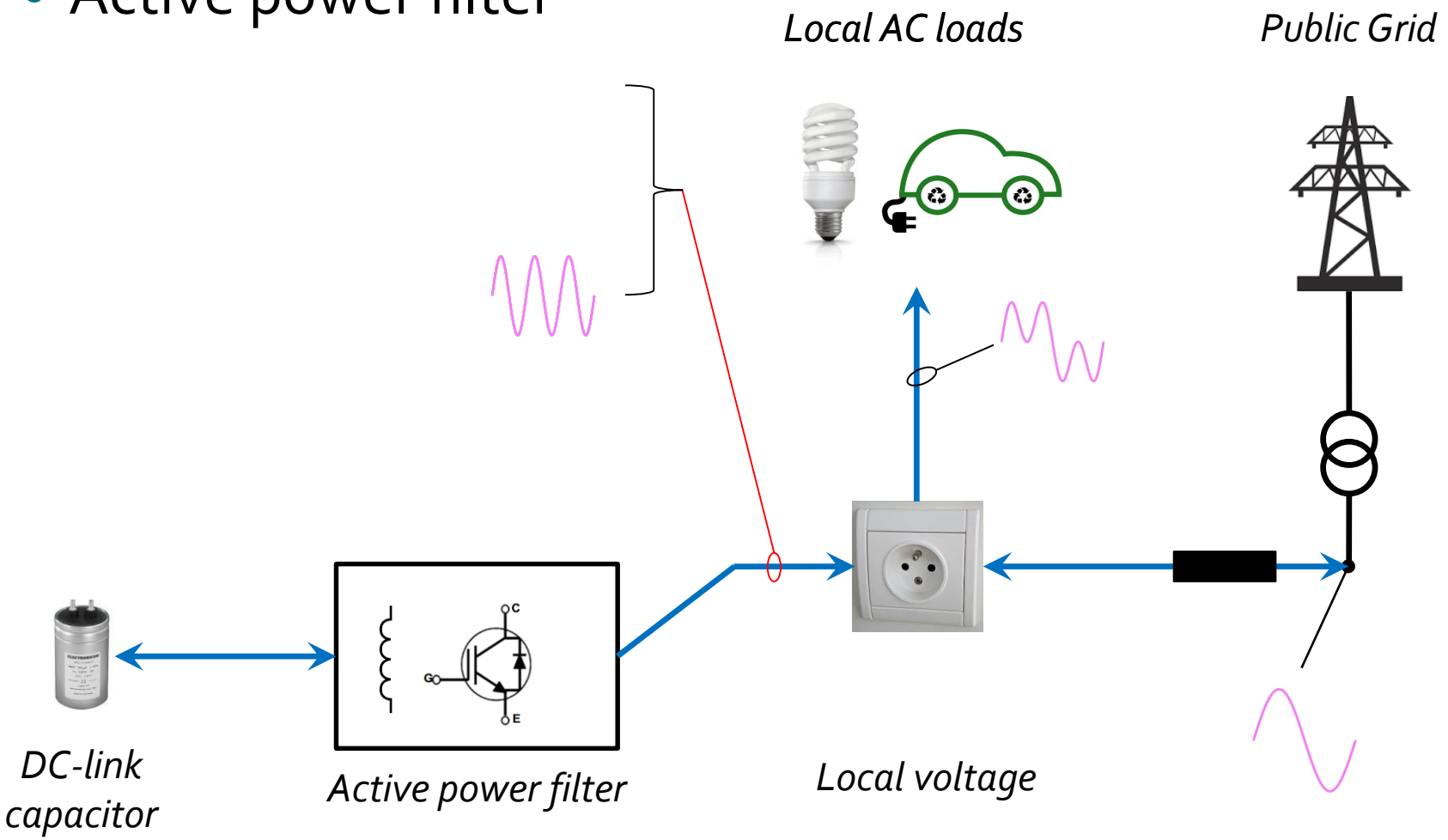
➢ Distorted local voltage

- Sensitive devices disturbed;
- Local loads efficiency decreased → cost;
- Grid current quality impaired.

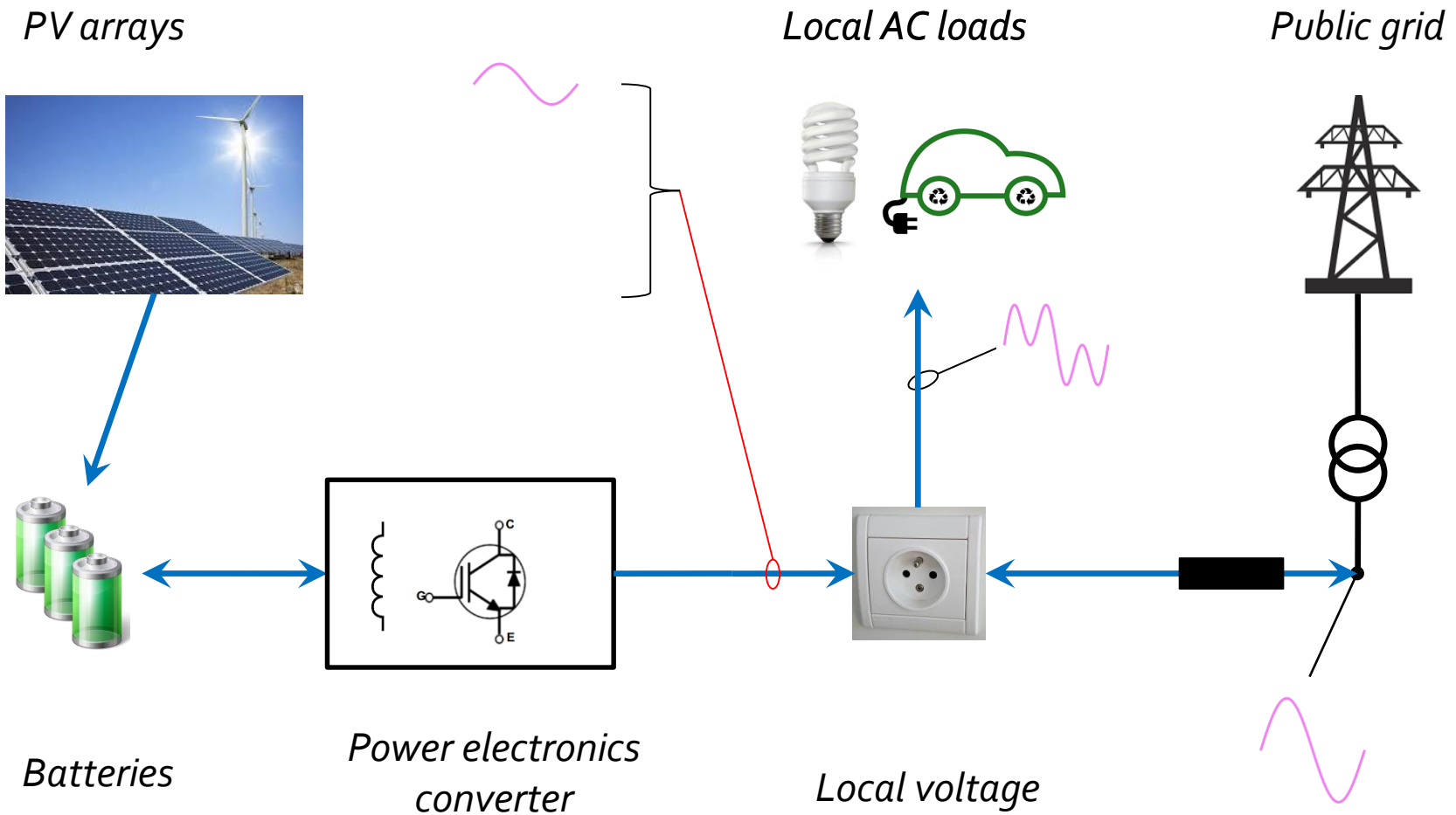


Background(3/4): Conventional solution

- Active power filter

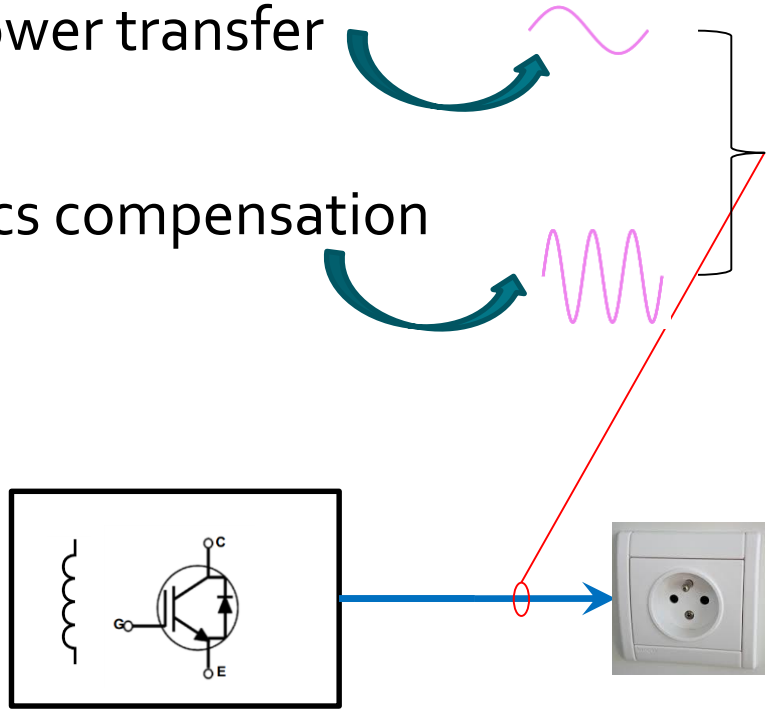


Background(4/4): Existing resources



Proposed solution

- Upgrading control algorithm; no additional sensors
  - Active power transfer
  - Harmonics compensation



Power electronics converter

Local voltage

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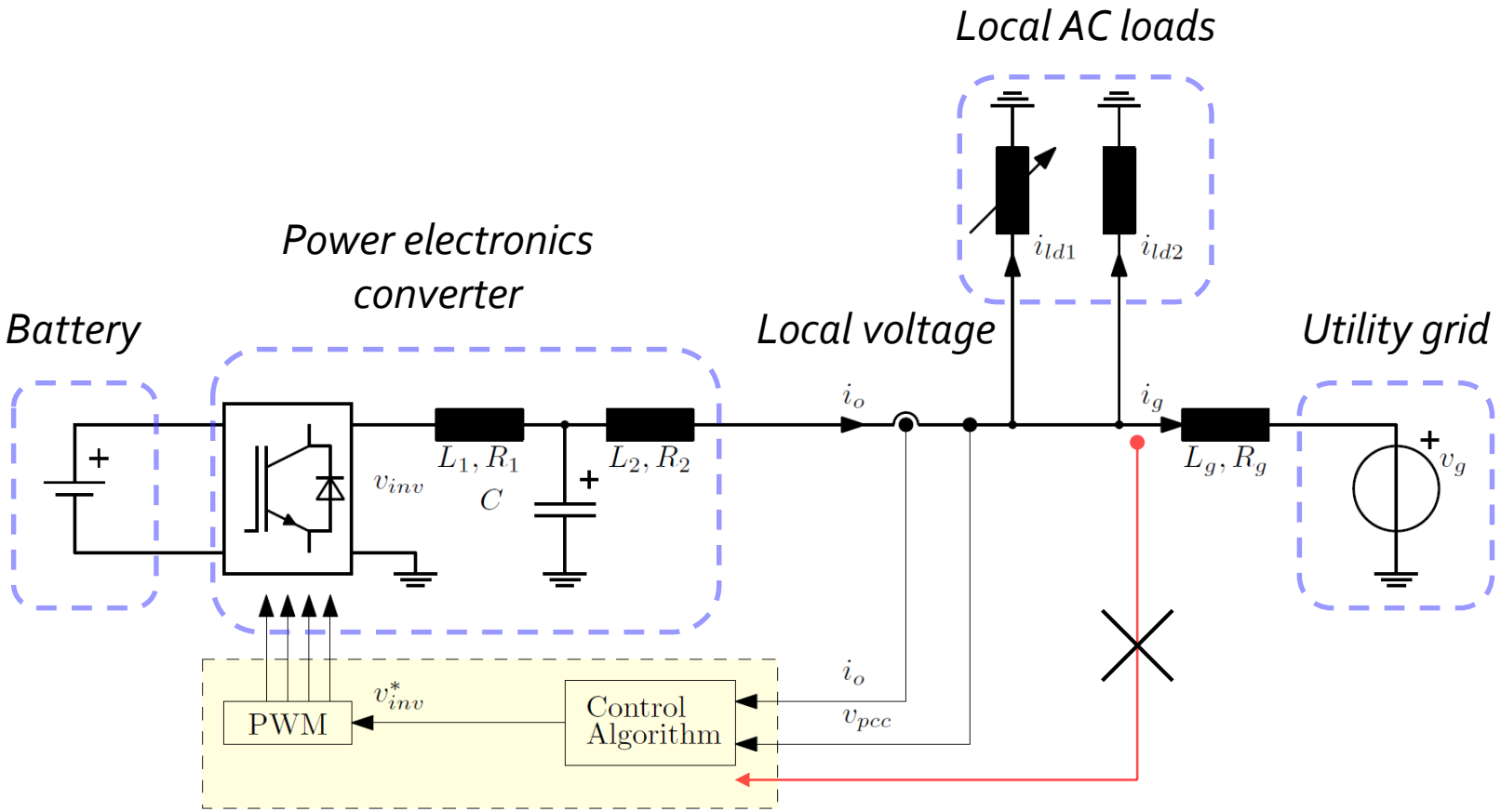
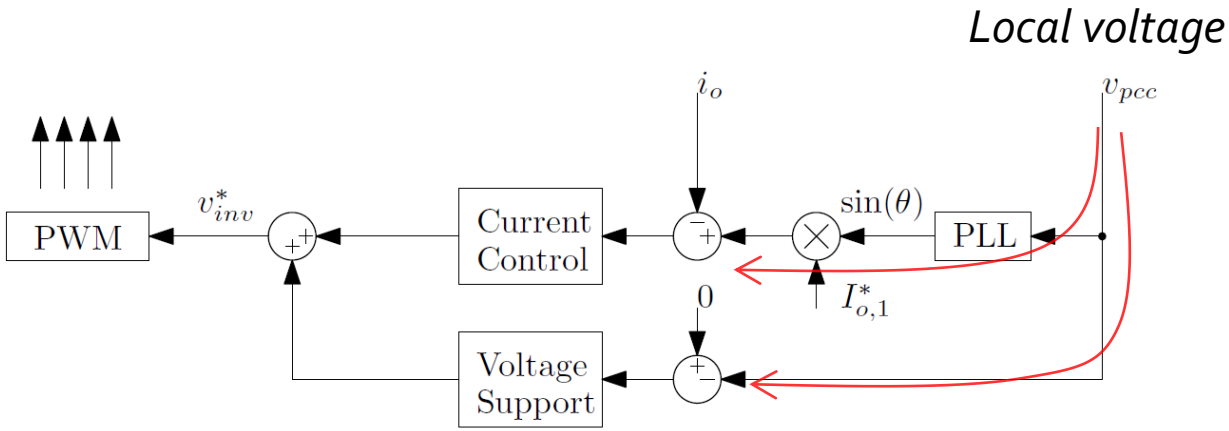
Control strategy in the application scope

- Upgrading control algorithm; no additional sensors



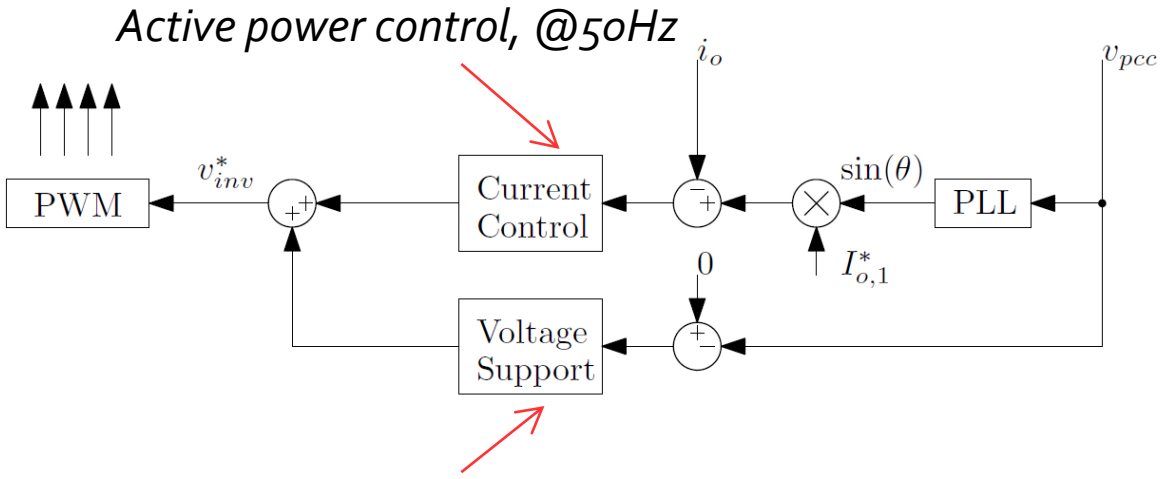
Control strategy framework (1/2)

- The local voltage measurement is used for
  - Grid synchronization ***(traditional usage)***
  - Harmonics detection/suppression ***(added usage)***
- No need for additional sensors



Control strategy framework (2/2)

- Active power transfer and harmonics compensation working at different frequencies
- No interferences between them



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Comparison between before & after (1/2)

- #1, Simulation

[1]

[2]

**[1] not published*
**[2] not published*

Comparison between before & after (2/2)

- #1, Experiments

[1]

[2]

**[1] not published*
**[2] not published*

Investigate of active power transfer (1/2)

- #2, Simulation - fundamental output current regulation.

[1]

- @ $I_{o,1}^{*} = 0A$

[2]

- @ $I_{o,1}^{*} = 2A$

**[1] not published*
**[2] not published*

Investigate of active power transfer (2/2)

- #2, Experiments - fundamental output current regulation.

[1]

- @ $I_{o,1}^{*} = 0A$

[2]

- @ $I_{o,1}^{*} = 2A$

**[1] not published*
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Comparison between simu. & exp.

- Harmonics suppression in the local voltage
  - Before & after in simulation/experiments

[1]

- Simulation

[2]

- Experiments

**[1] not published*
**[2] not published*

Comparison between simu. & exp.

- Regulating fundamental output current in order to control active power transfer

[1]

**[1] not published*

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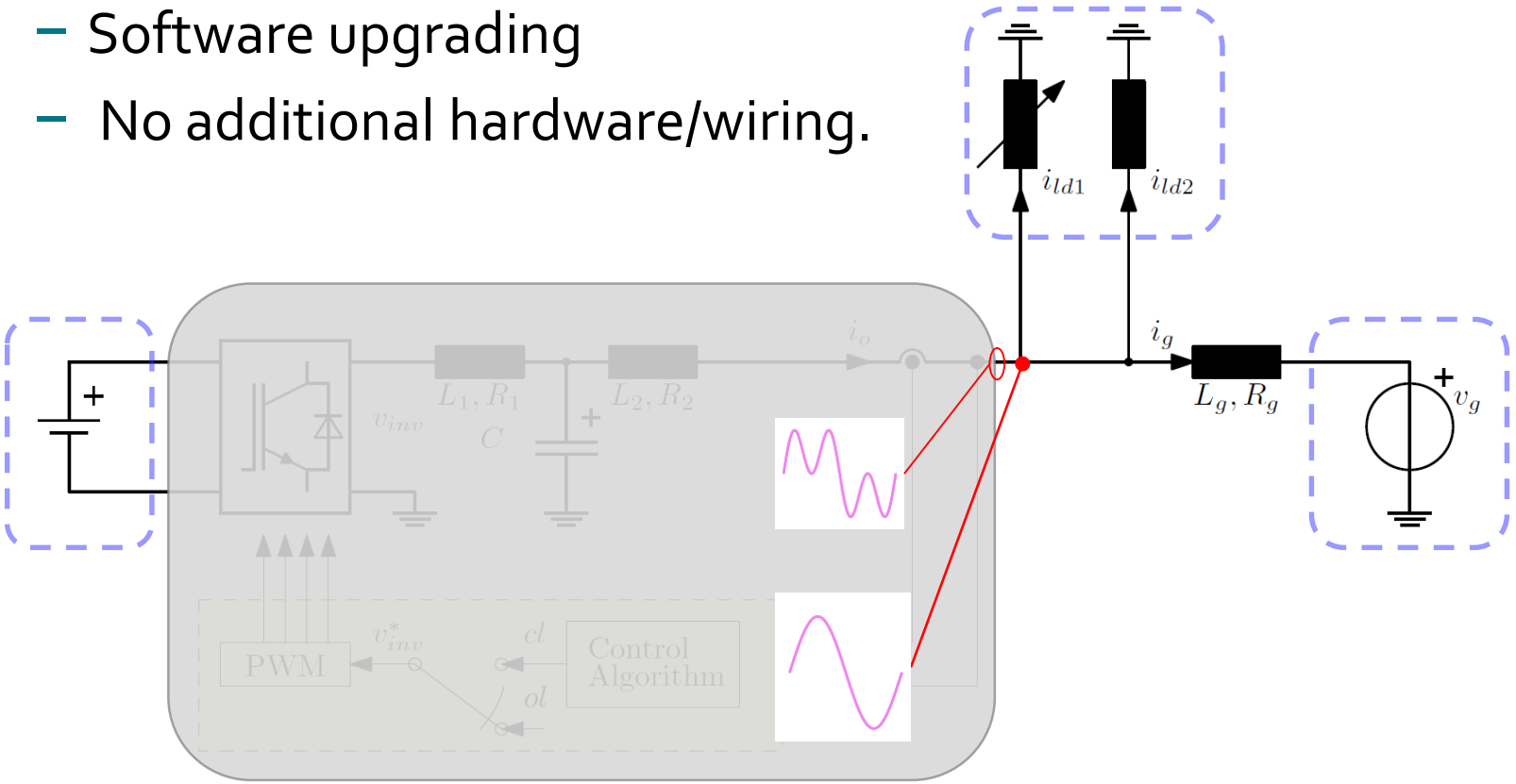
Summary

- Upgrade existing grid-connected converters for:
  - Active power transfer & Local voltage support
  - Software upgrading
  - No additional hardware/wiring.



Conclusion

- Control strategy proposed for the purposes of
  - Harmonics compensation (***added feature***)
  - Active power regulation
- Feasibility verified in simulation and experiments.

- Benefit:
  - Only control algorithm upgrading;
  - No need to measure the grid or load current.

Thanks!

Thank you for your attention !

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