Hochschule
München
University of
Applied Sciences

Laboratory for
Mechatronic
and Renewable
Energy Systems
(LMRES)

Power Electronics in Bavaria(in Bavaria)

... and how adding intelligence makes it the enabling technology for the “Energiewende”

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HM

Outline I

Outline I

Power Electronics in Bavaria

Motivation: The future low-inertia power system—A likely guess [1]

- more distributed generation / renewable energy systems
- diminishing mechanical inertia
- hybrid grid and transmission topologies (e.g. AC & DC)
- more unbalanced faults ($> 75\%$ of faults already today)
- more loosely-coupled & unbalanced micro-grids
- more power electronics

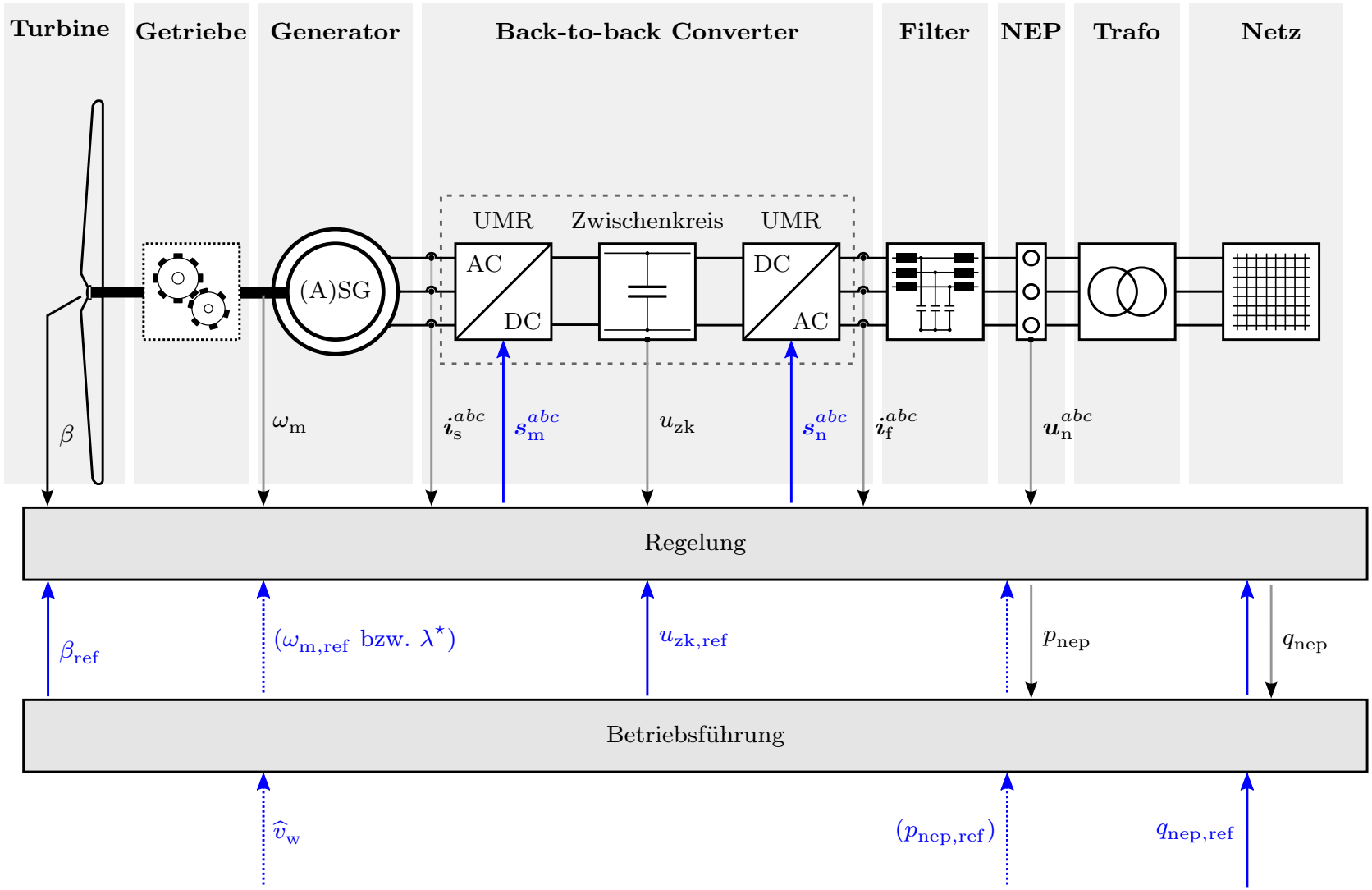
$\Longrightarrow$ Faster dynamics/transients, more harmonics & weaker overall grid!

$\Longrightarrow$ Reliable power electronics and grid parameter estimation crucial

$\Longrightarrow$ ... for balancing, harmonics suppression, frequency/voltage support!

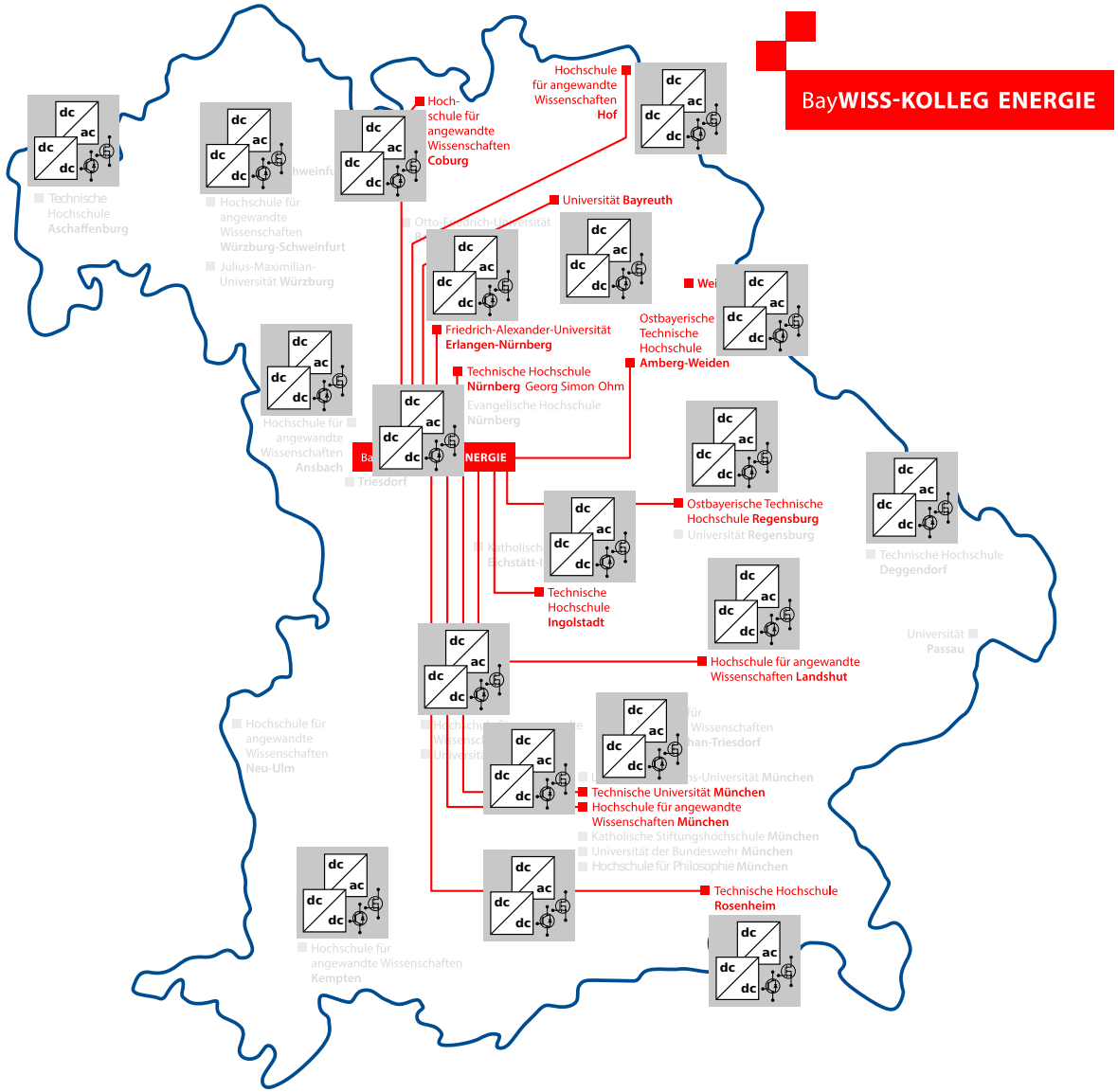
Power Electronics in Bavaria

Motivation: Wind turbine with synchronous generator



Power Electronics in Bavaria

Research and teaching centers



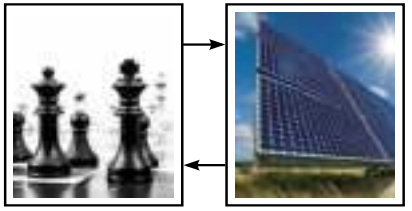
Power Electronics in Bavaria

LMRES Research projects (focus on **modeling**, **simulation**, **control**, **efficiency** & **reliability**)

Windkraftanlagen

Kleinwindkraftanlagen

(N)MPC für RES



Flugwindkraftanlagen

Geothermieanlagen

Wellenkraftanlagen

Elektrofahrzeuge

Stromnetz

Biogasanlagen

Mehrlevel-Umrichter

Elektrische Antriebe

Bewegungssteuerung

Outline I

2 Intelligent power electronics (two examples)
- Compensation of open-switch converter faults
- Grid parameter estimation

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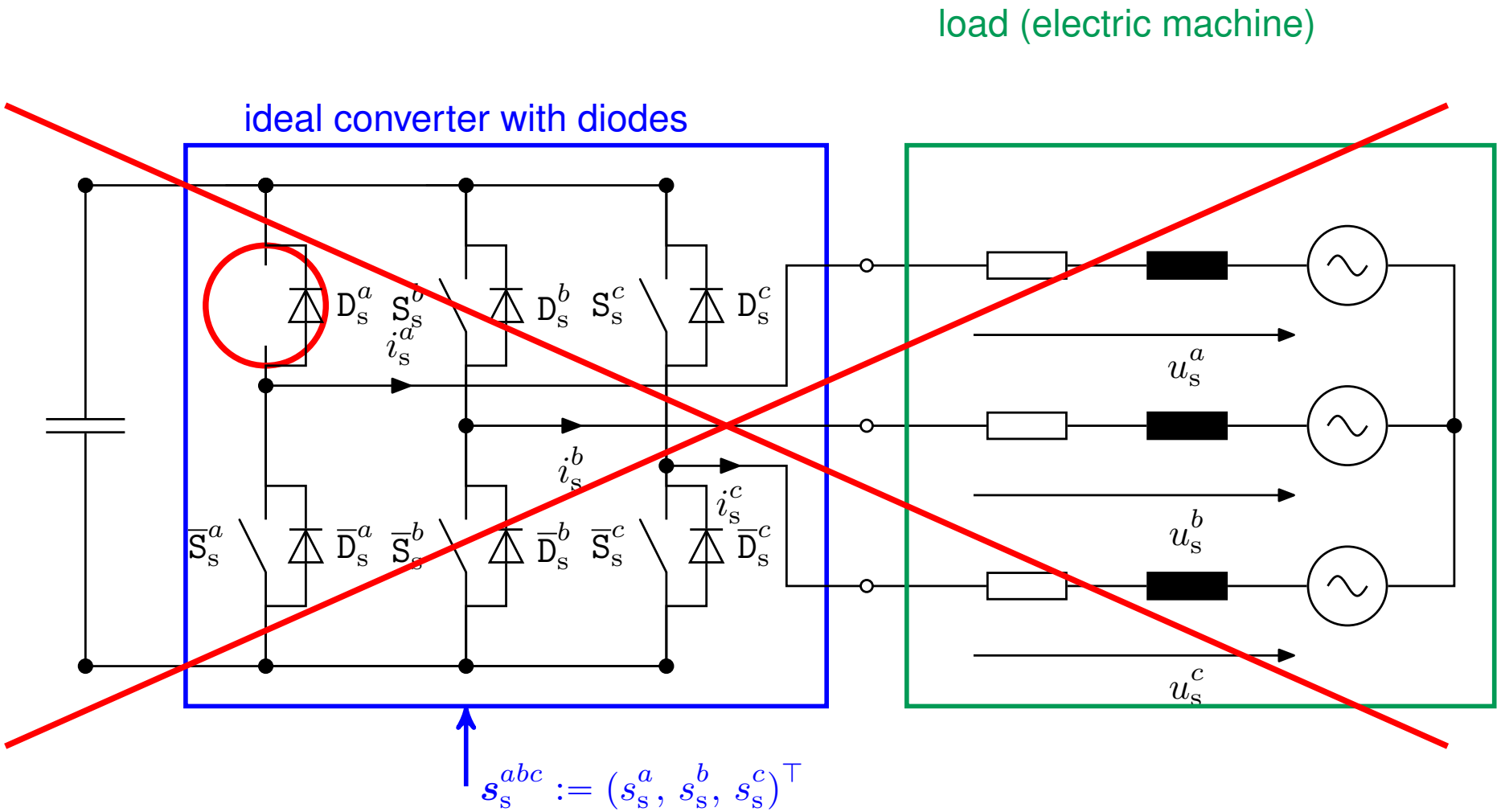
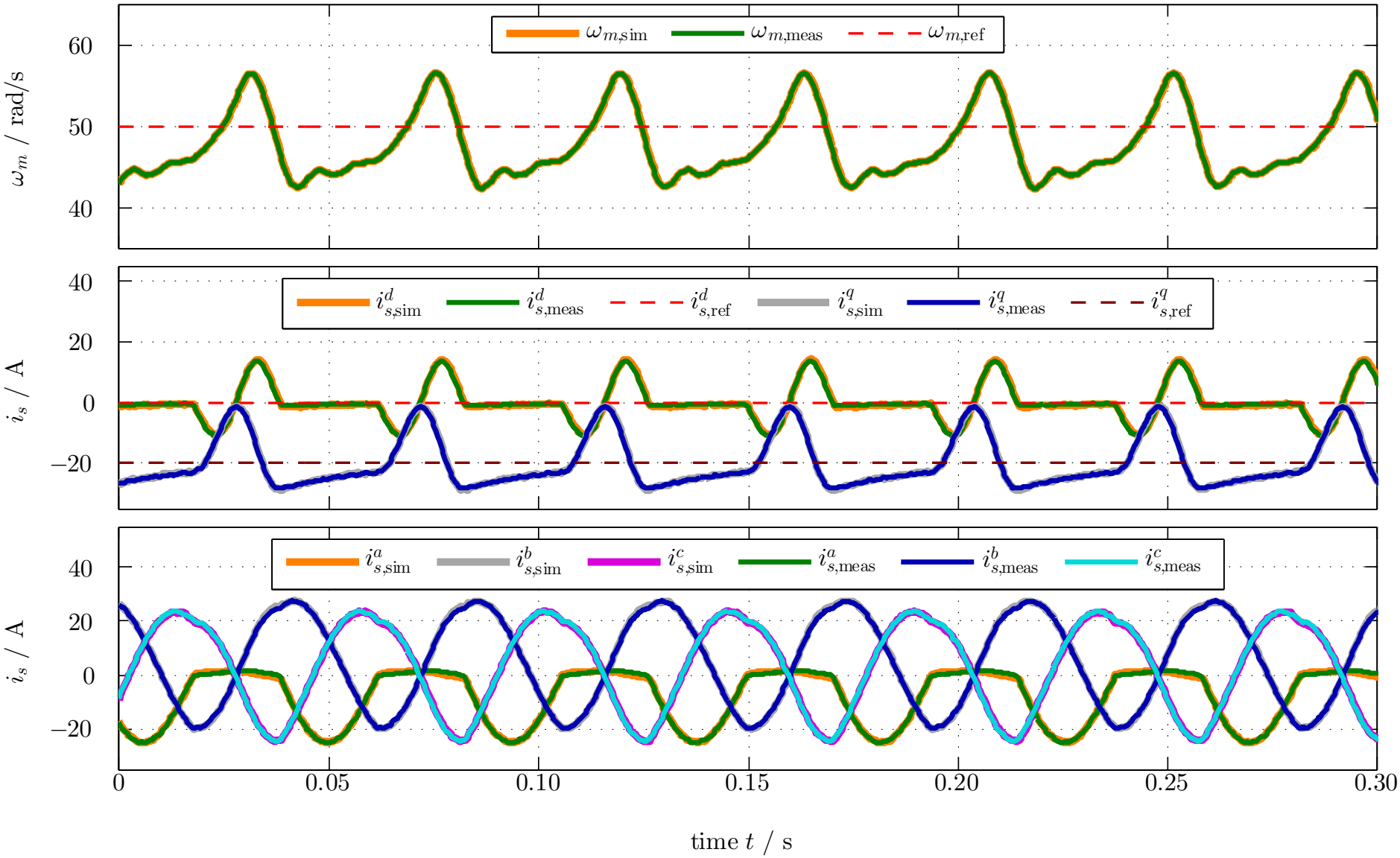
Intelligent power electronics

Compensation of open-switch converter faults [2]: Motivation



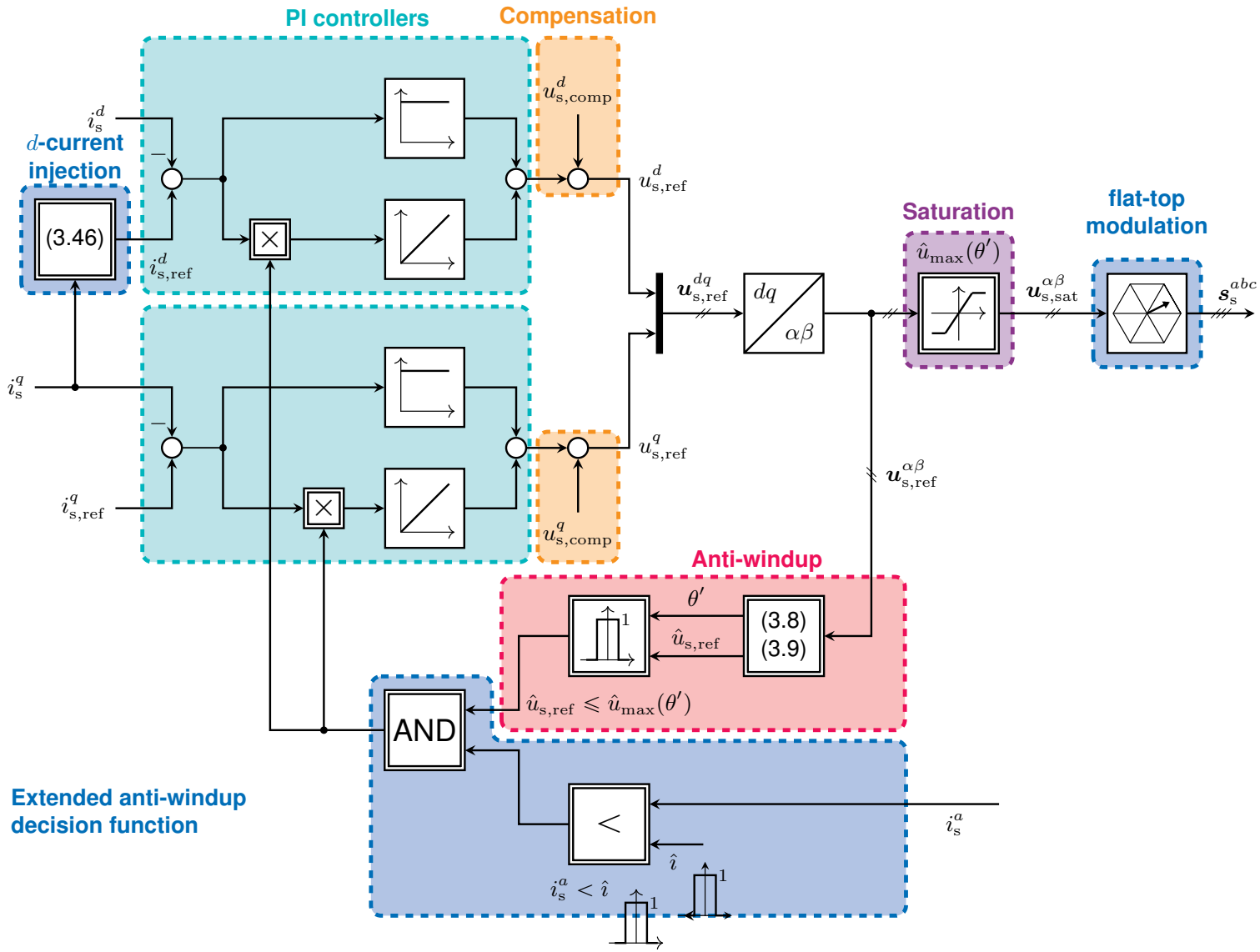
Intelligent power electronics

Compensation of open-switch converter faults [2]: Results with fault



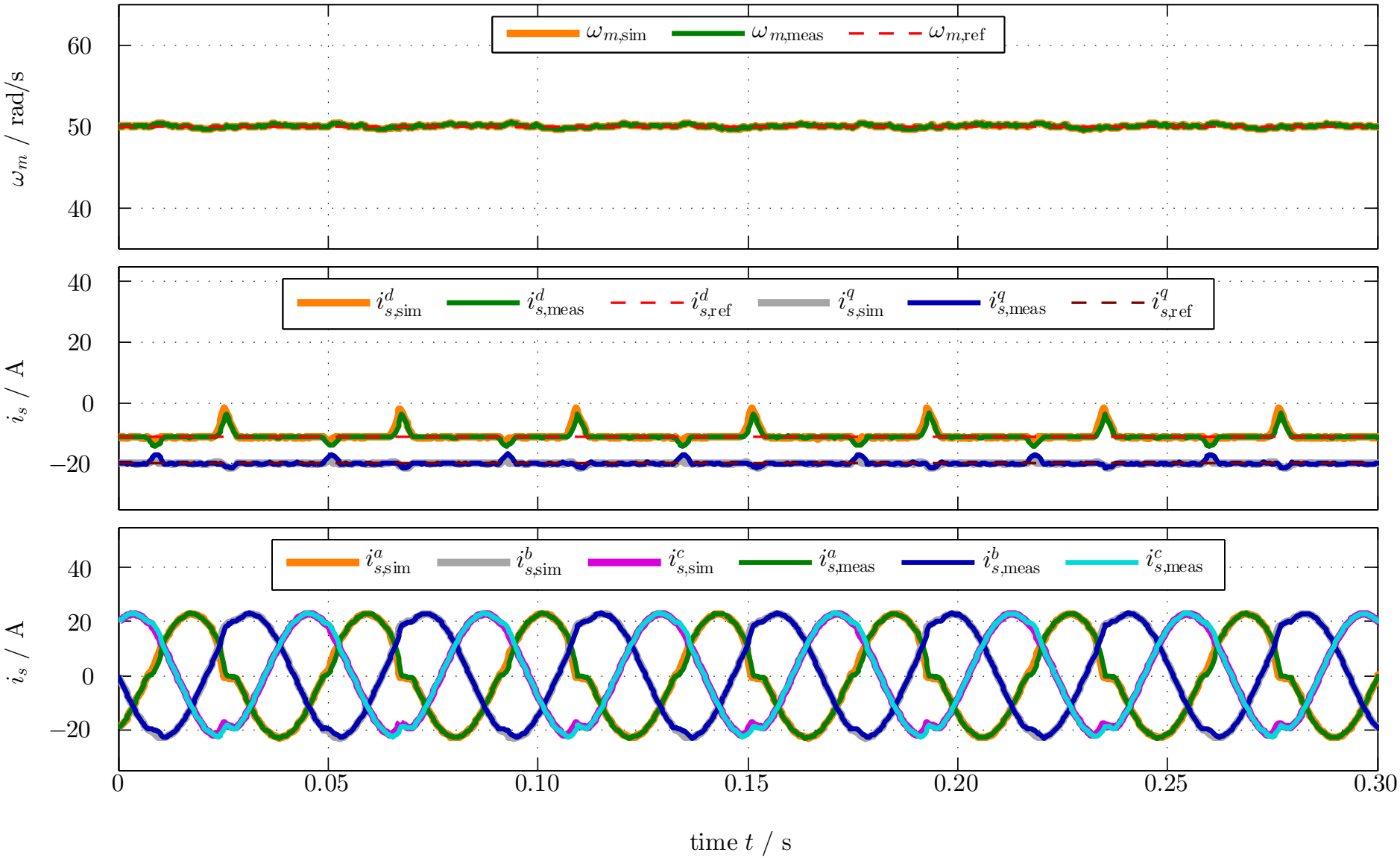
Intelligent power electronics

Compensation of open-switch converter faults [2]: Solution – fault-tolerant controller



Intelligent power electronics

Compensation of open-switch converter faults [2]: Results with fault-tolerant controller



Outline I

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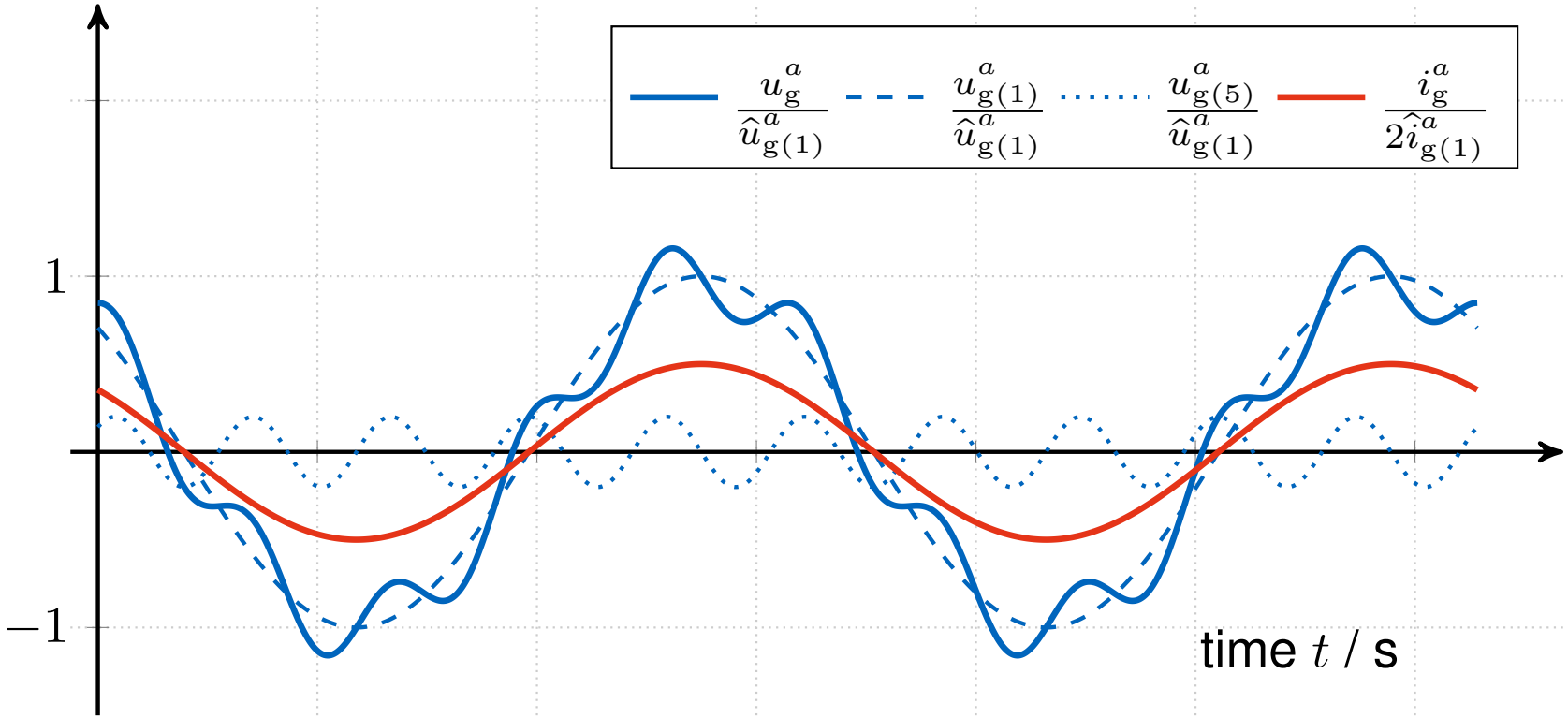
Intelligent power electronics

Grid parameter estimation [3, 4, 5]: Motivation

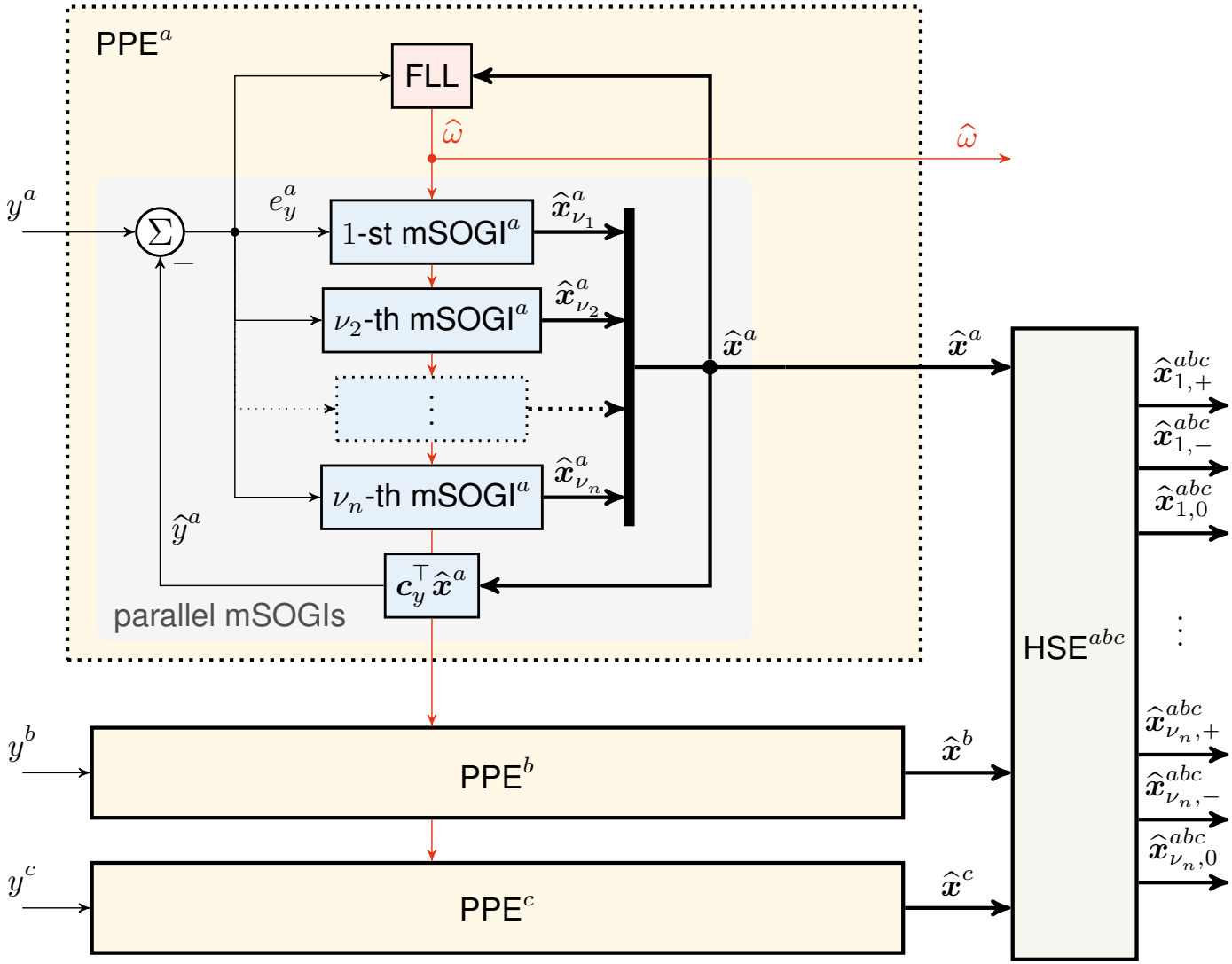


$\Longrightarrow$ Estimation of fundamental voltage component $u_{\mathrm{g}(1)}^{a}$

$\Longrightarrow$ Phase-correct current $i_{\mathrm{g}}^{a} = i_{\mathrm{g}(1)}^{a}$ (e.g. for active/reactive power)

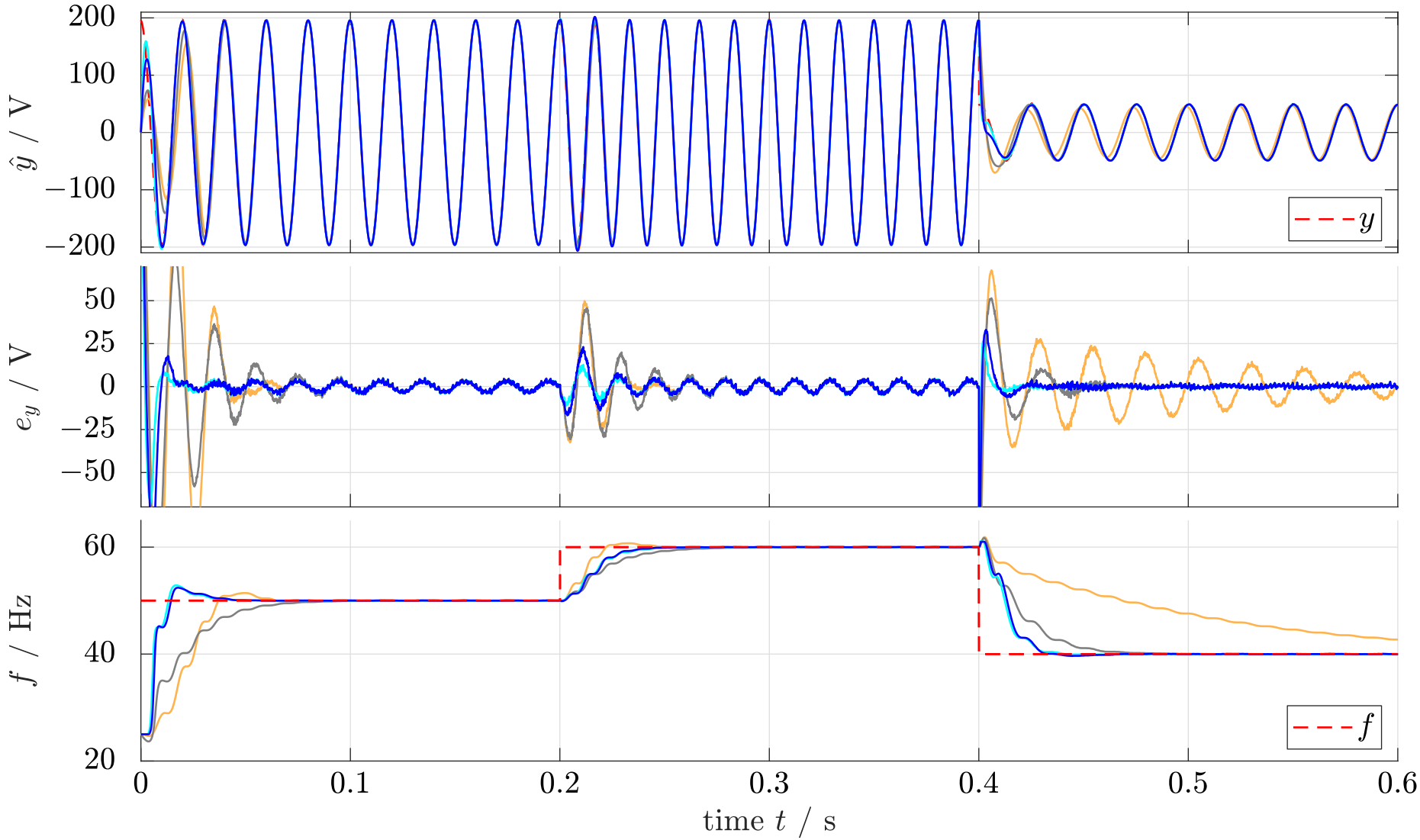
Intelligent power electronics

Grid parameter estimation: Solution



Intelligent power electronics

Grid parameter estimation: Measurement results **with** FLL (mSOGI, $\text{mSOGI}_{\text{fast}}$, sSOGI & ANF)



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