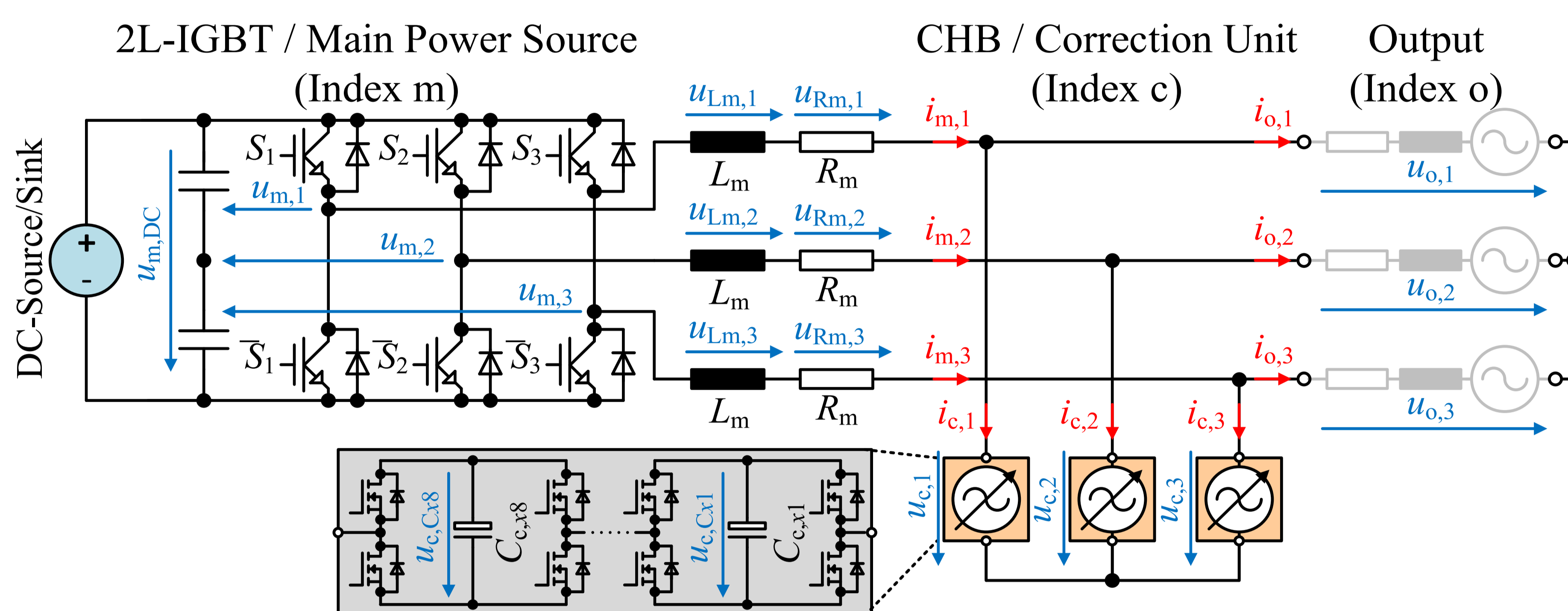


Cascaded H-Bridge based Parallel Hybrid Converter - A novel Topology for perfectly sinusoidal high power Voltage Sources

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Novel Cascaded H-Bridge based Parallel Hybrid Converter (PHC)



Basic Idea:

- High power: Cheap 2L-IGBT converter
- Ripple Correction: Low power CHB

Output

- Voltage only defined by the "Correction Unit" (CU)
 $u_o = u_c$
- Current only delivered by the "Main Power Source" (MPS)
 $i_{o,123} = i_{m,123} - i_{c,123} \approx i_{m,123}$

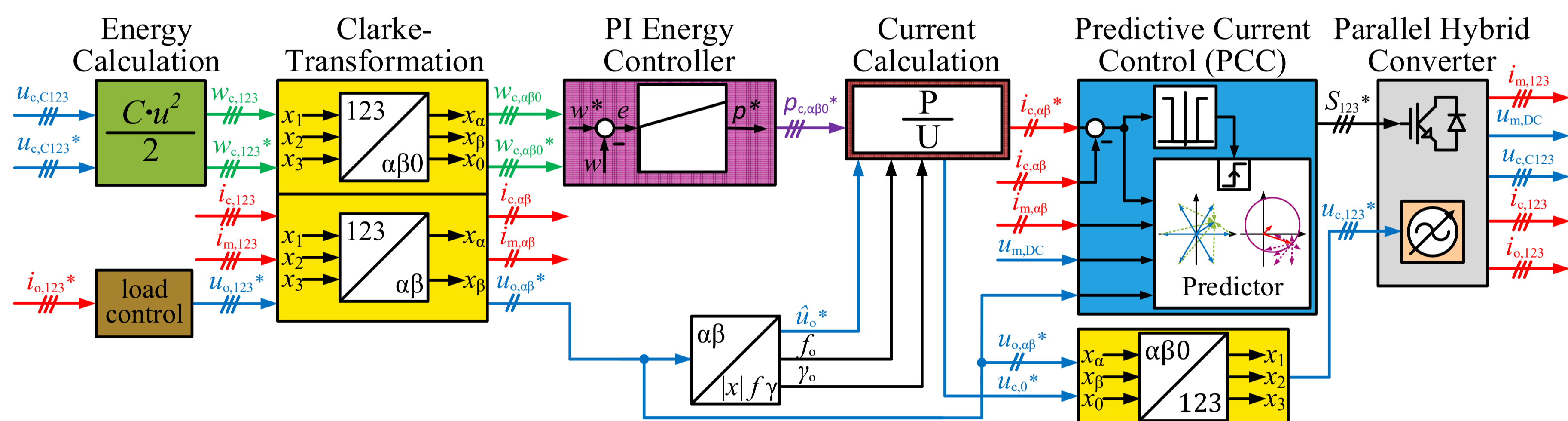
Correction Unit

- Low-power Cascaded H-Bridge converter (CHB)

Main Power Source

- High-power two level IGBT converter (2L-IGBT)

Cascaded control scheme for energy and current control



Energy controllers

- Three PI Controller balance the CHB cell capacitor voltages

Current Calculation

- Converts the power reference values p_c^* to current reference values i_c^* depending on the operating point

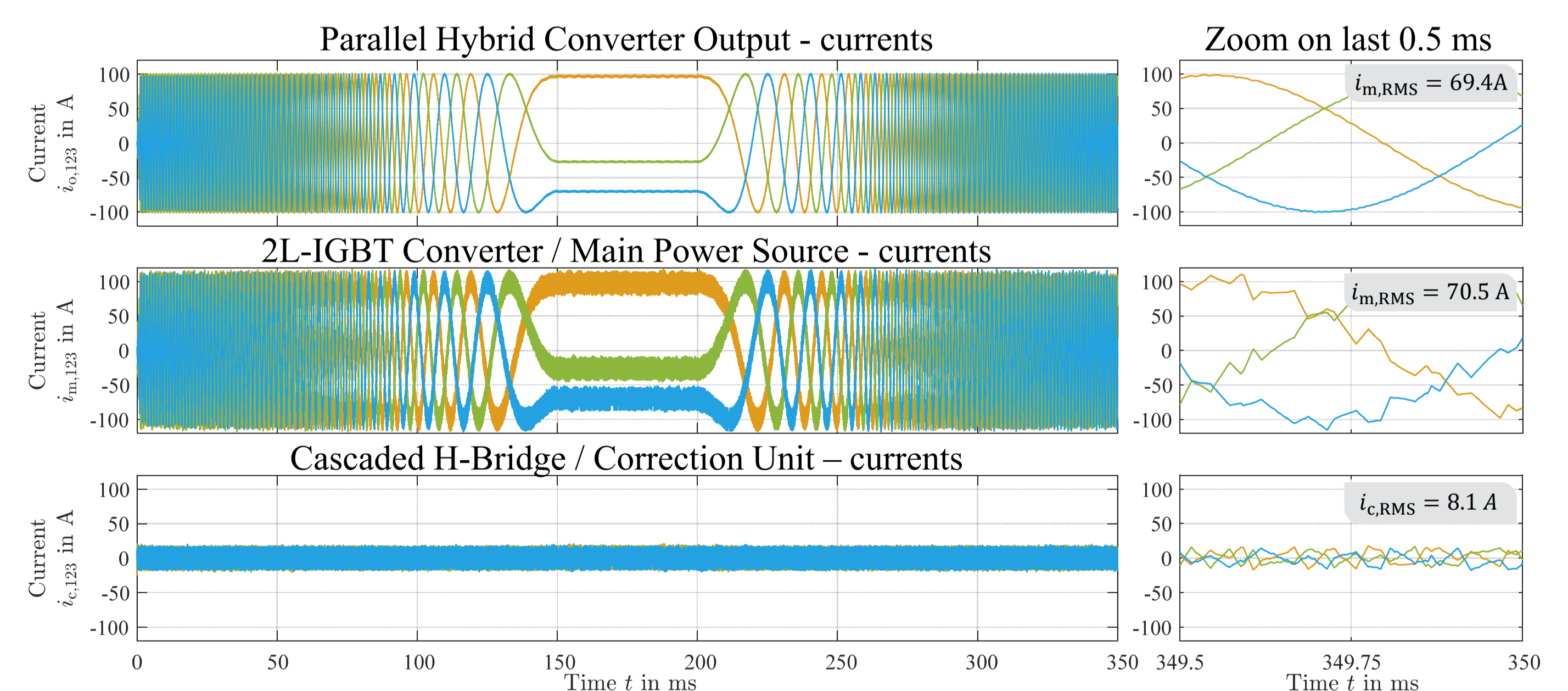
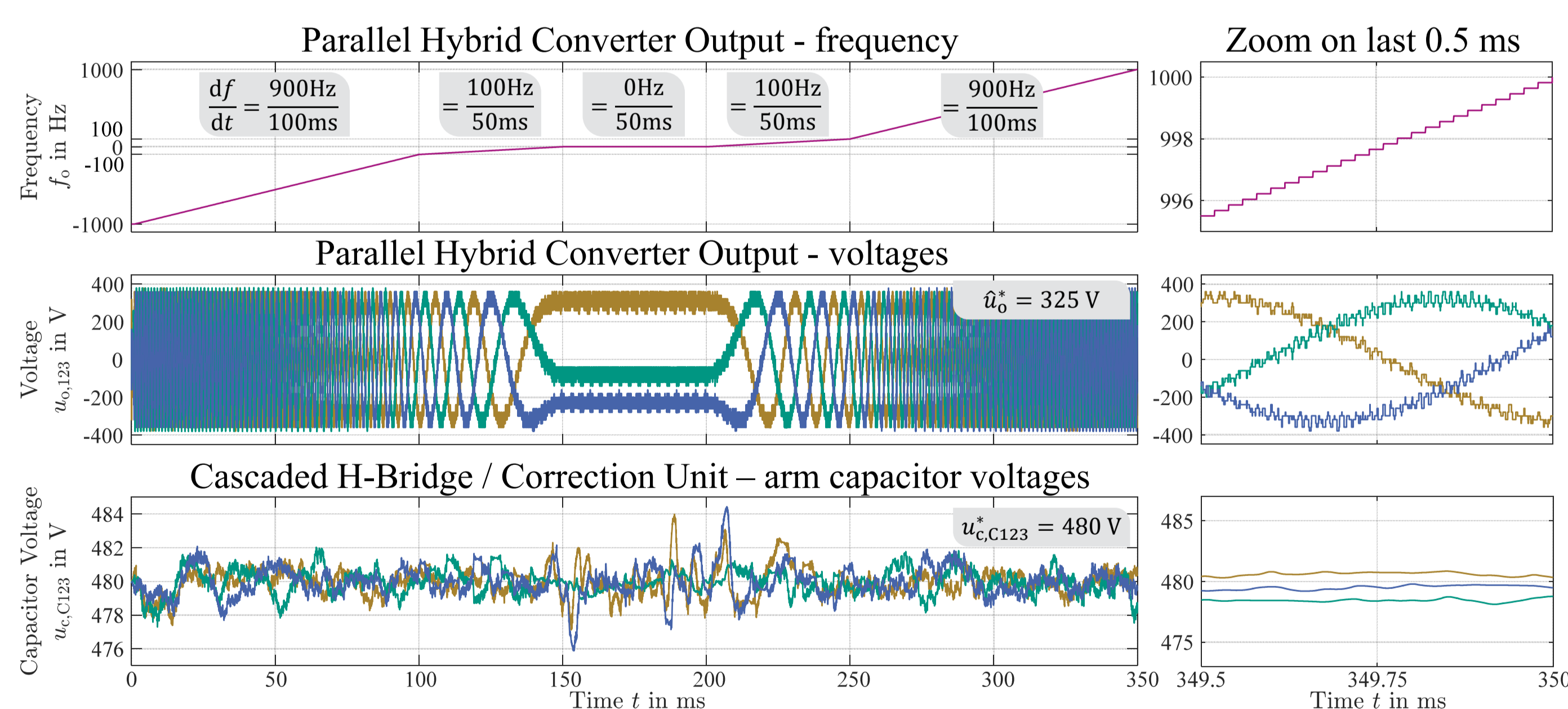
Predictive Current Controller

- Determines the switching states of the IGBTs and therefore controls and limits the CHB currents

Load Control

- Depends on the application

Simulation results for the control concept with a RL-Load



Conclusion

■ The novel Parallel Hybrid Converter:

- High precision and high dynamic terminal behavior similar to state of the art multilevel converters (e.g. Modular Multilevel Converters or Modular Multiphase Multilevel Converter)
- Significantly reduced costs and a significantly improved power density compared to state of the art multilevel converters!
- Can replace single high power and expensive multilevel converters!

■ The proposed control concept:

- The CHB current is perfectly limited to its boundary value, leading to a CHB RMS current value of 12 % of the value of the 2L-IGBT converter
- The average switching frequency of the Main Power Source is kept low (≈ 9 kHz), allowing the use of low cost IGBTs
- The CHB arm capacitor voltages are perfectly balanced over the entire output frequency range!

Outlook

- A 50 kW prototype is under construction and will be used for Power-Hardware-in-the-Loop Emulation of electrical machines and small power grids