

Parallelization of EMT solution for integration of IBR in large scale transmission grids

SC C4

PS3/Q3.11

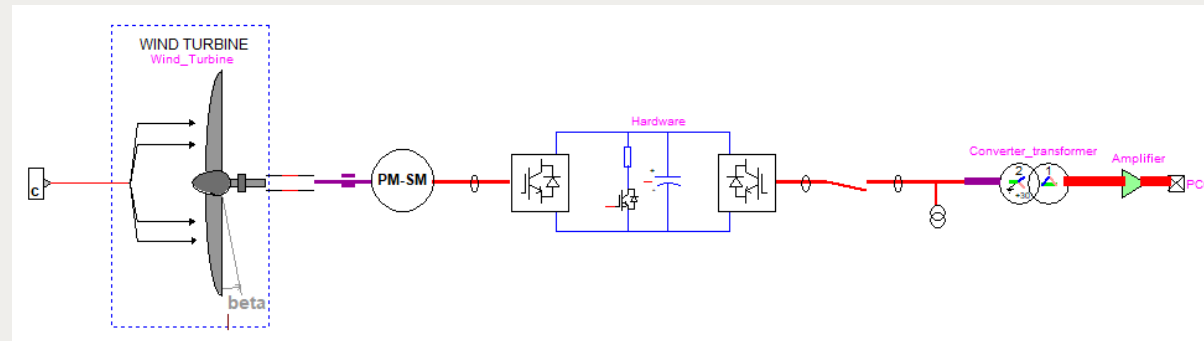
What are the latest initiatives for reducing the computational time of offline wide-area EMT simulation for power systems with high share of inverter-based resources, and how are these off-line models compared in general against wide-area real-time EMT models??

B. BRUNED (France)



Saint-Nazaire offshore wind park model in EMTP

- WTG model for EMT simulation provided by suppliers
 - Black box model provided by WTG supplier
 - Include Wind Farm Controller
 - Designed for aggregation (with current amplifier) but can be used to represent individual WTG
- EMT simulation of detailed park are usually not practical due to long simulation time
- Fast simulation of detailed park can be achieved with parallel computing



Example of Type 4 aggregated wind turbine model

Main advantage of parallel computing:

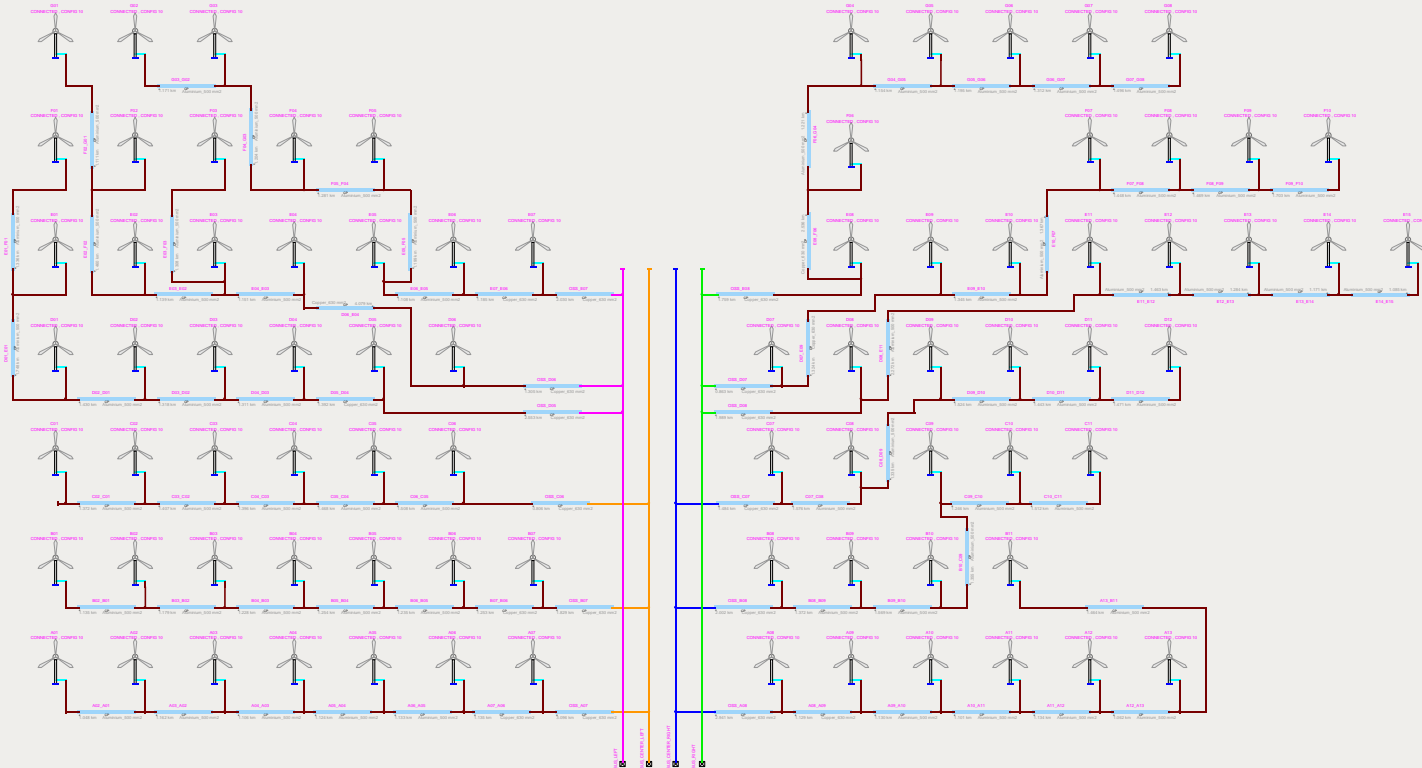
- Remove current amplifier
- Represent all the WT and detailed layout of the park
- Simulation time similar to the simulation time for aggregated model

Group Discussion Meeting

Saint-Nazaire offshore wind park model in EMTP

EMT simulation with detailed wind park models can be used to:

- Analyze collector grid faults and collector grid overcurrent protection system performance
- LVRT and HVRT capability studies



Detailed view of the Saint Nazaire Offshore WPP with individual WT model in EMTP

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Parallelization of EMTP via co-simulation

- The co-simulation method is used to interface multiple instances of EMTP
- The natural propagation delays in cable models allow to decouple a network into several subnetworks
- Subnetworks can be solved in parallel without any approximation
- Each instance solves its own subnetwork and shares data at every time-step

Parallelization of the Saint-Nazaire offshore WPP

- Onshore grid is represented by a Thevenin equivalent
- 40 wind turbines model
- Power plant controller (PPC) included
- The simulation time-step is 4 μ s
- Simulation time is 6.5 s
- 41 instances of EMTP run in parallel

Test case	Computation time (s)	Speed up ratio
Reference case (1 CPU)	49,672	1
Parallel solution (41 CPU)	2037	24.38

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