Co-simulation tool for EMTP-RV

June 2013, Xavier Legrand, EDF R&D

EMTP-RV UG

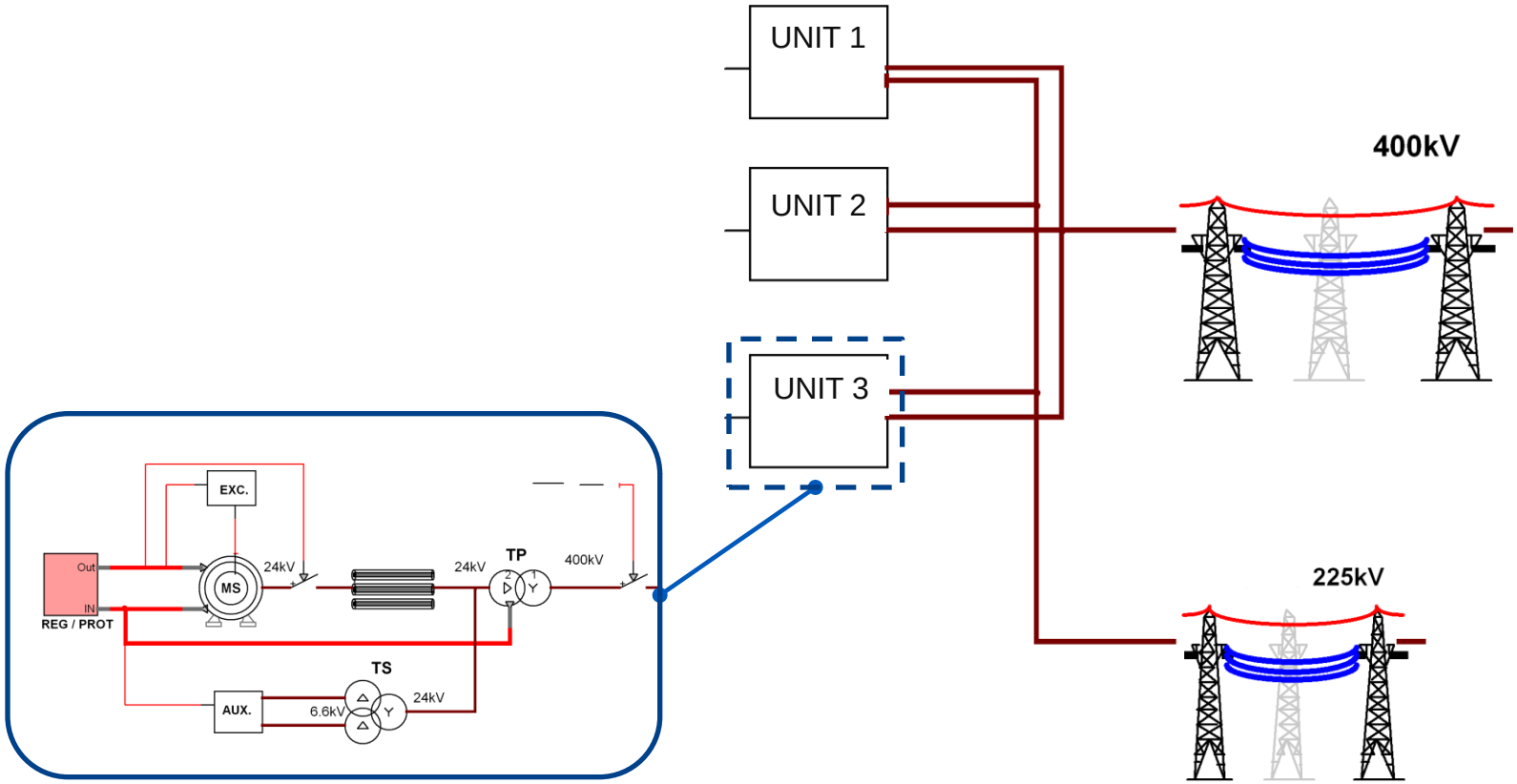
CHANGER L'ÉNERGIE ENSEMBLE

Outline

Co-simulation with EMTP-RV : why ?
Co-simultation tool : Example
Test Case
Conclusion

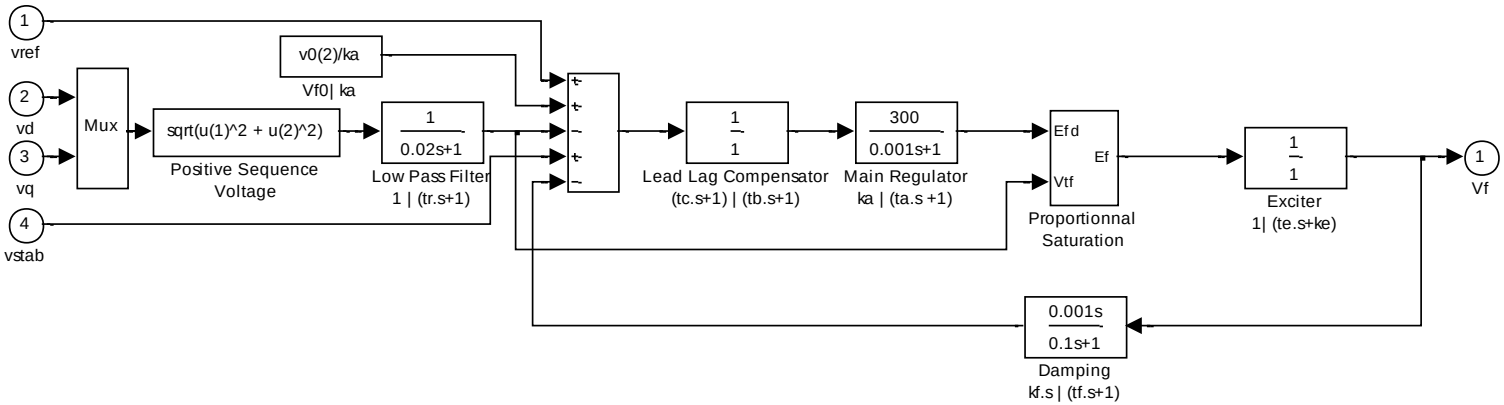
Co-simulation with EMTP-RV : why ?

- **Electric Utility : EMTP-type modeling for transients studies:**
  - Electrotechnic components of the system (lines, transformers, machines, …).
  - Validated models (egs. power plants models on EMTP-RV for EDF).



Co-simulation with EMTP-RV : why ?

- **Vendors : not necessary the same code for all parts of their system:**
  - Egs. Machine controls on Simulink, mechanical parts on dedicated codes ….



Co-simulation with EMTP-RV : why ?

- **Electric Utility : EMTP-Rv modeling for transients studies**
- **Vendors : models based on other softwares**

➢ **How can we compute the behavior of the complete system ?**

Co-simulation with EMTP-RV : why ?

- **Some solutions for utilities:**
  - **Re-coding the whole into the EMTP-Rv :**
    - Can be long / difficult;
    - Changes required for each manufacturer modification;
    - Tests : no validations by the vendor;
    - Need for all data (confidentiality?);
    - Can be asked to the manufacturer (request for proposal).
    - Only one tool is needed at the end.
    - **Ideal long term solution (only one solver, models added in libraries).**

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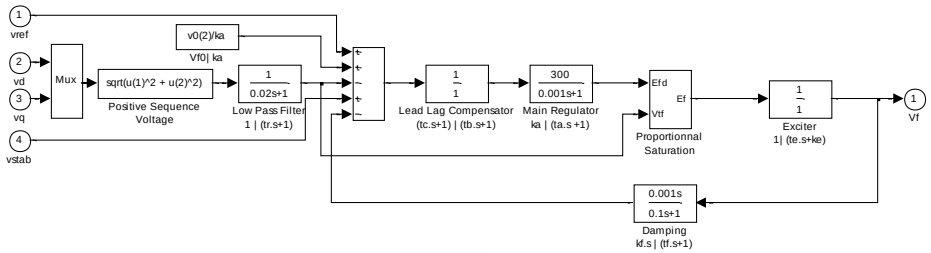
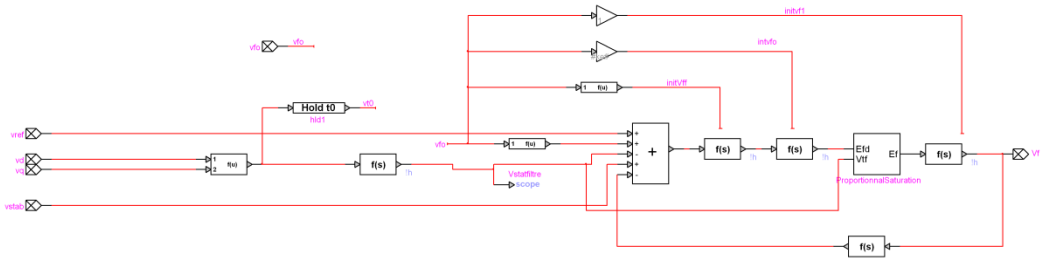


code 1



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  - **Black-box DLL approach**
    - Fast (almost direct with Simulink);
    - Code compiling required for each modification (even the time-step);
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    - 'Black box' : no requirement for all data.
    - Controls seen as 'black boxes'.
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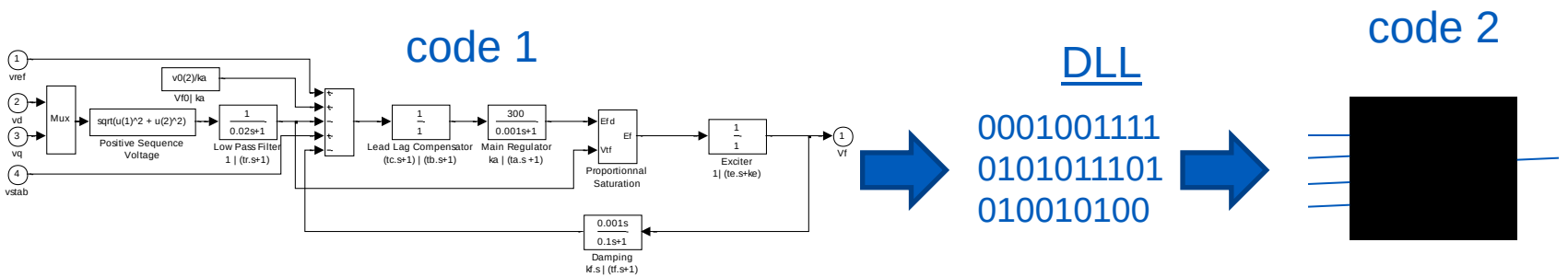

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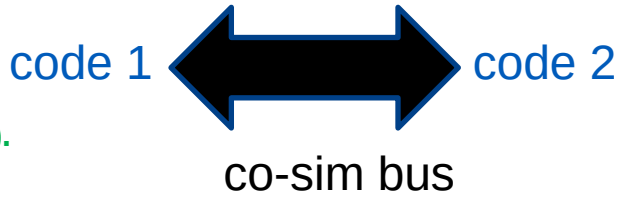

  - **Black-box DLL approach**
    - Almost direct with tools like Simulink (eRTW)
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    - Integrated models seen as 'black boxes'.
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    - Some numerical challenges (egs. Nodal based codes / State space based codes).

  - **Co-Simulation**
    - Almost direct with an appropriate co-simulation tool;
    - All parts can be direcly modified using their orginal GUI;
    - Tests : model validated by the manufacturer;
    - 'White box' ;
    - No requirement for all data (control blocks can be encripted in Simulink).
    - Both tools are needed (EMTP + Simulink).
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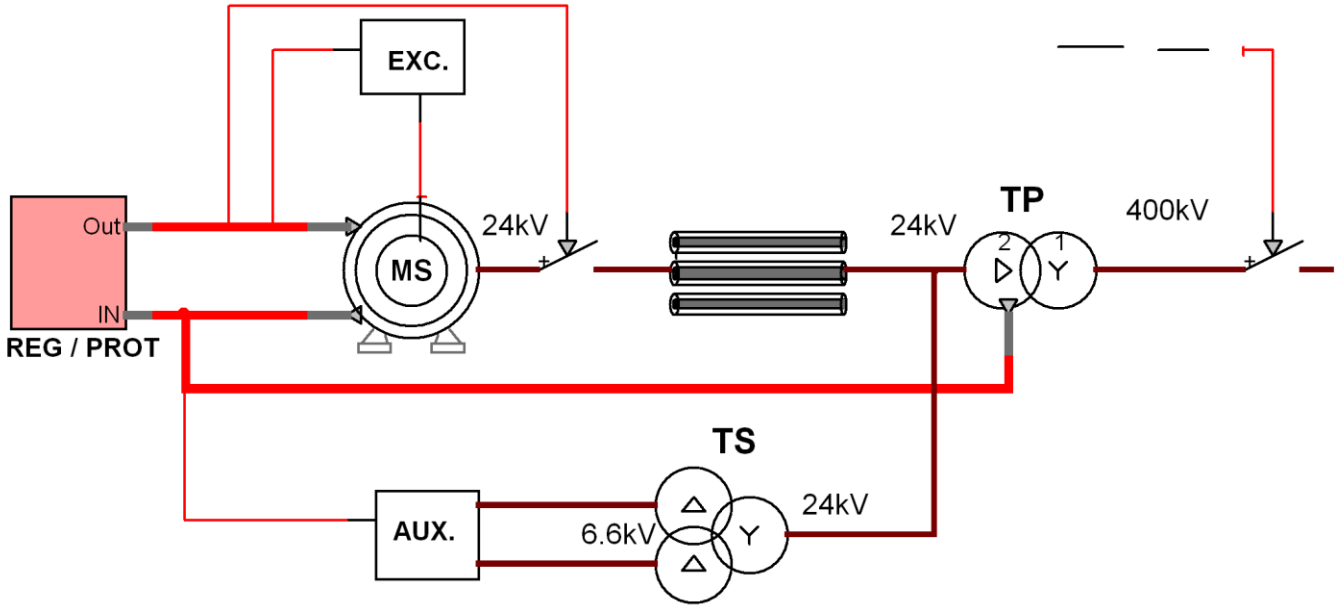
Co-simulation for power sys. studies : example

- **EDF : power plant library into EMTP-RV**
- New controls for the SM
- Vendor : Simulink models for the new controls
- > EMTP-RV / Simulink co-simulation



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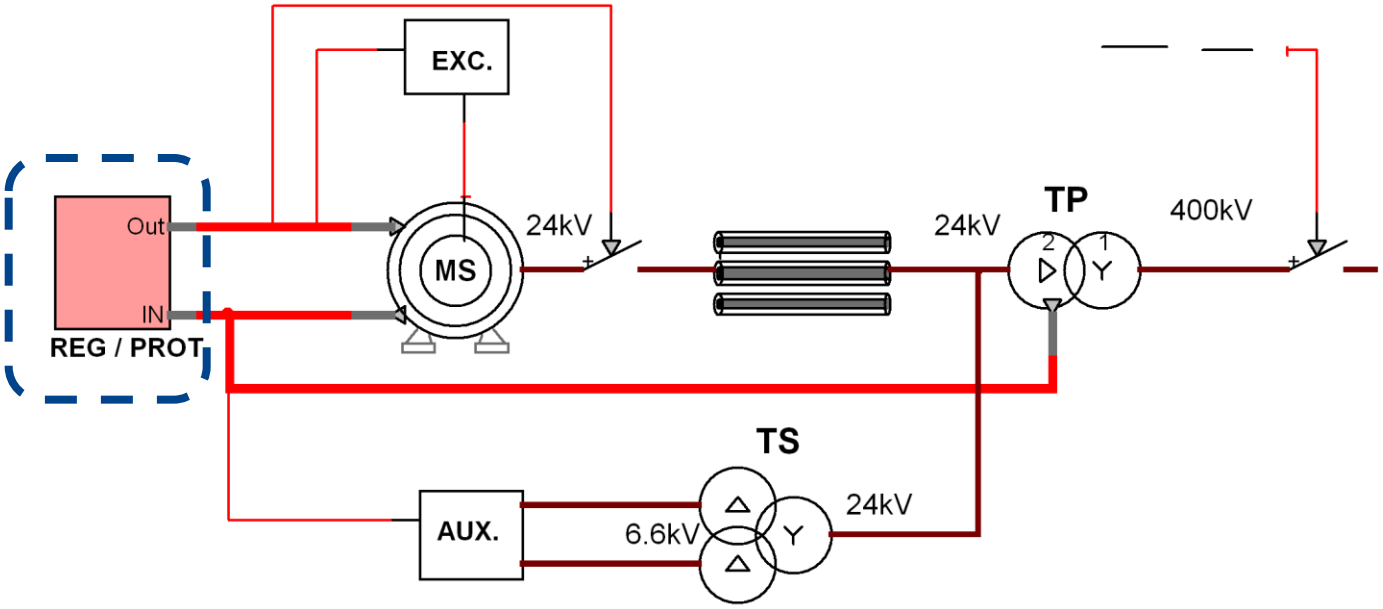

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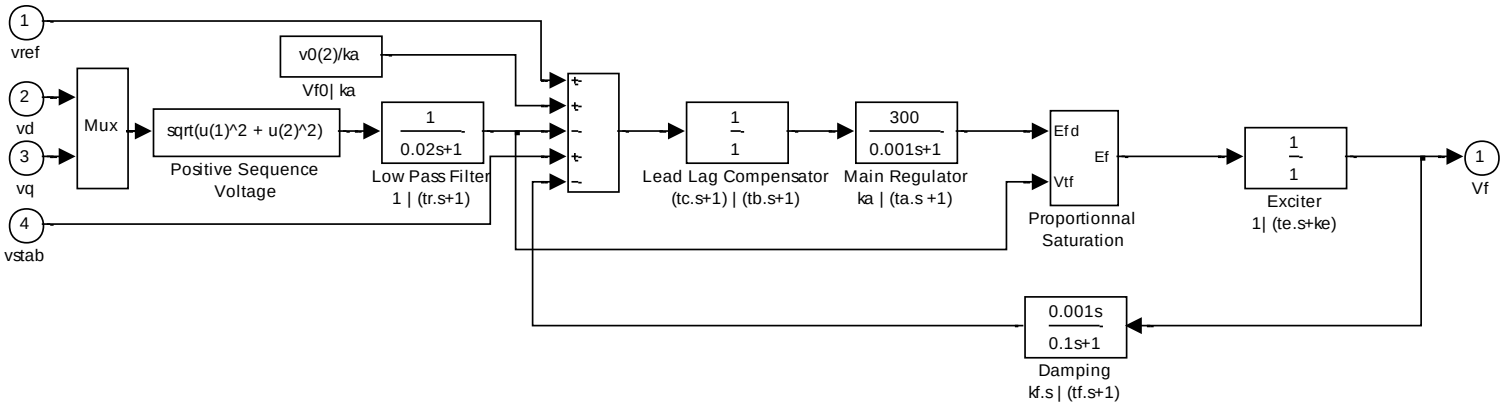

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⇒ **EMTP-RV / Simulink co-simulation using a co-simulation bus.**

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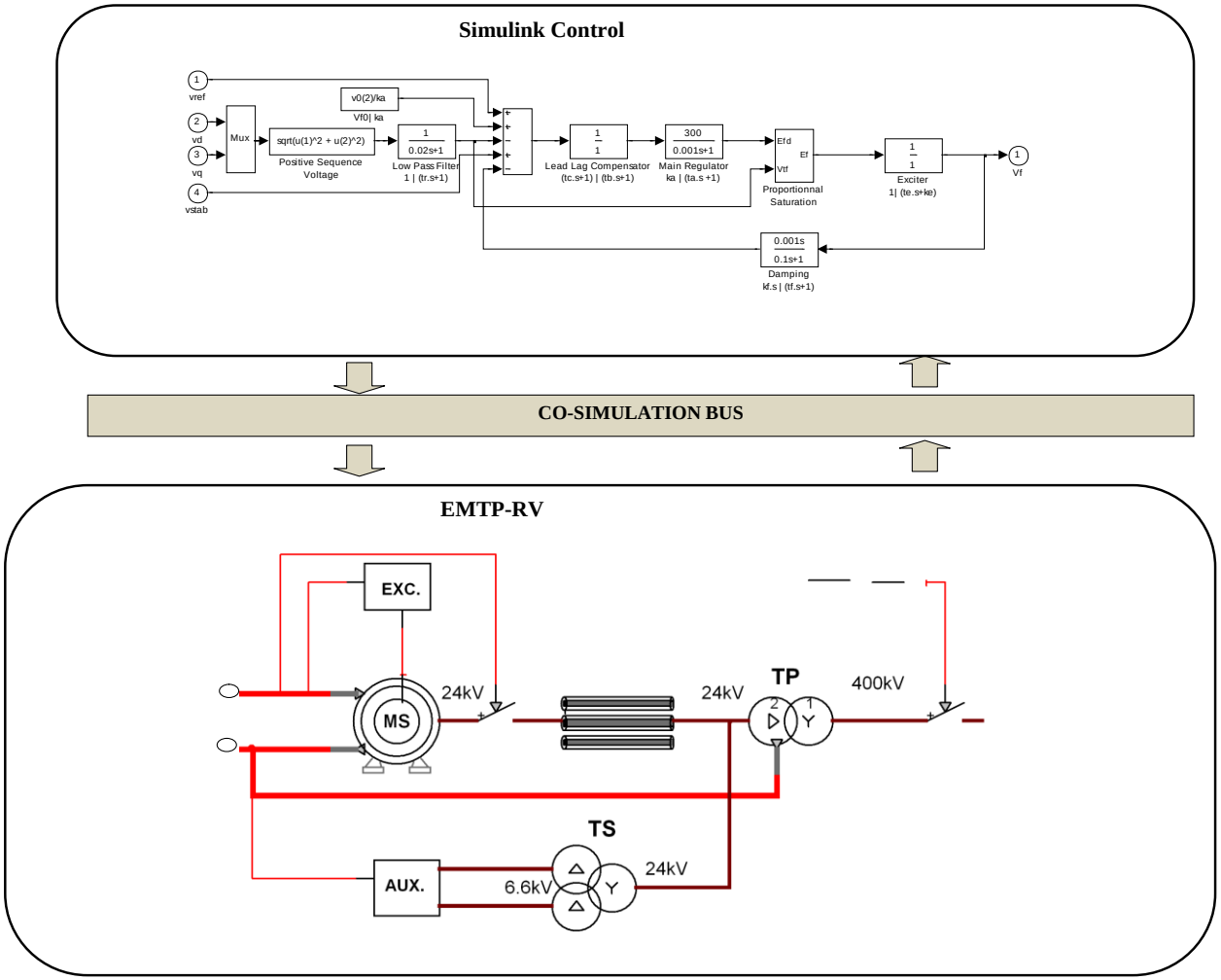
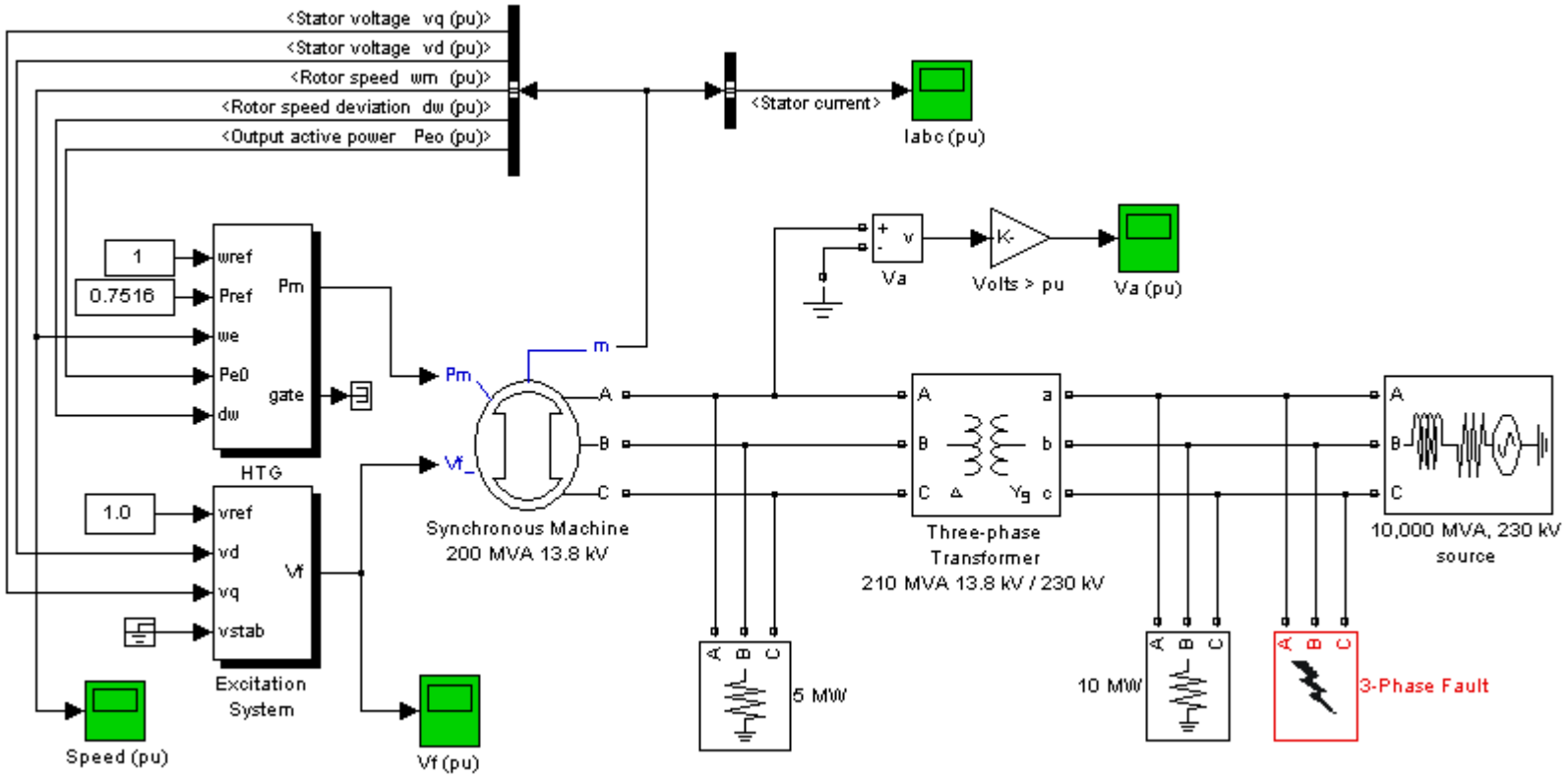


EMTP-RV/Simulink Co-simulation : test case

- **SPS 'Power Turbine' example**



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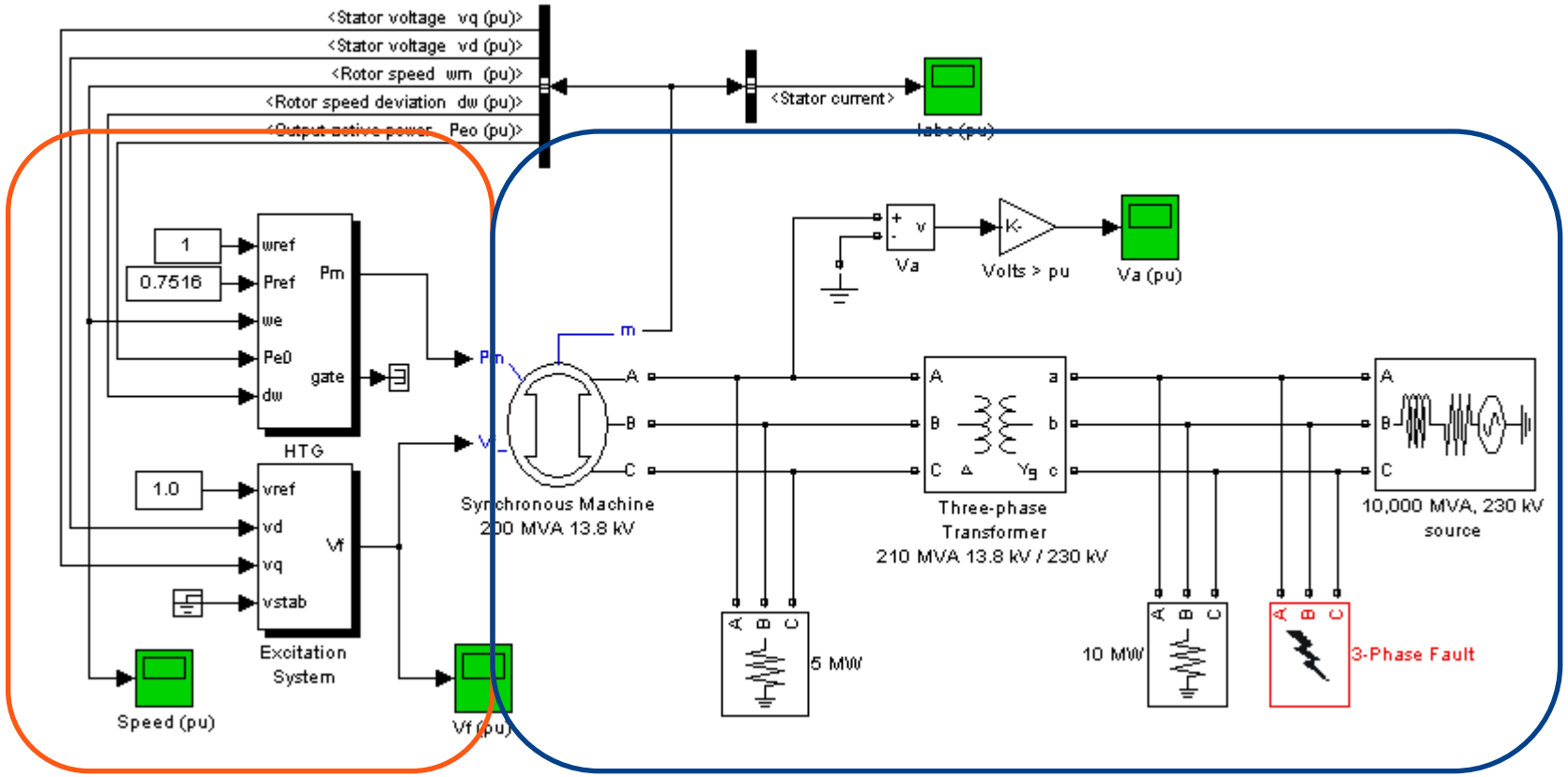

Control : Simulink

Electrotech. : EMTP-RV

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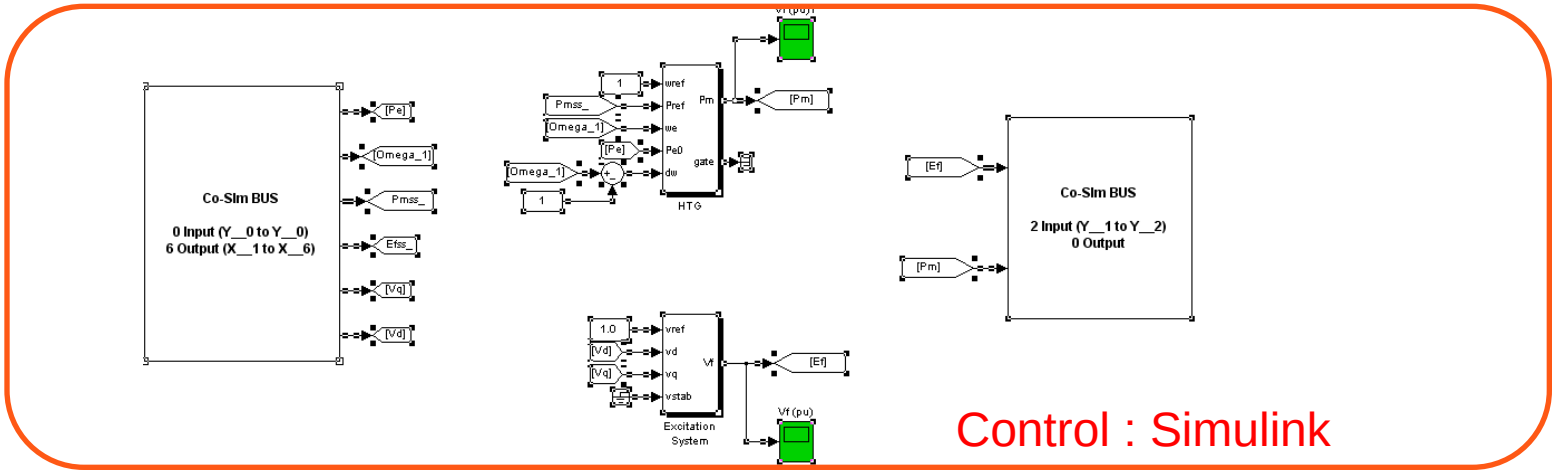

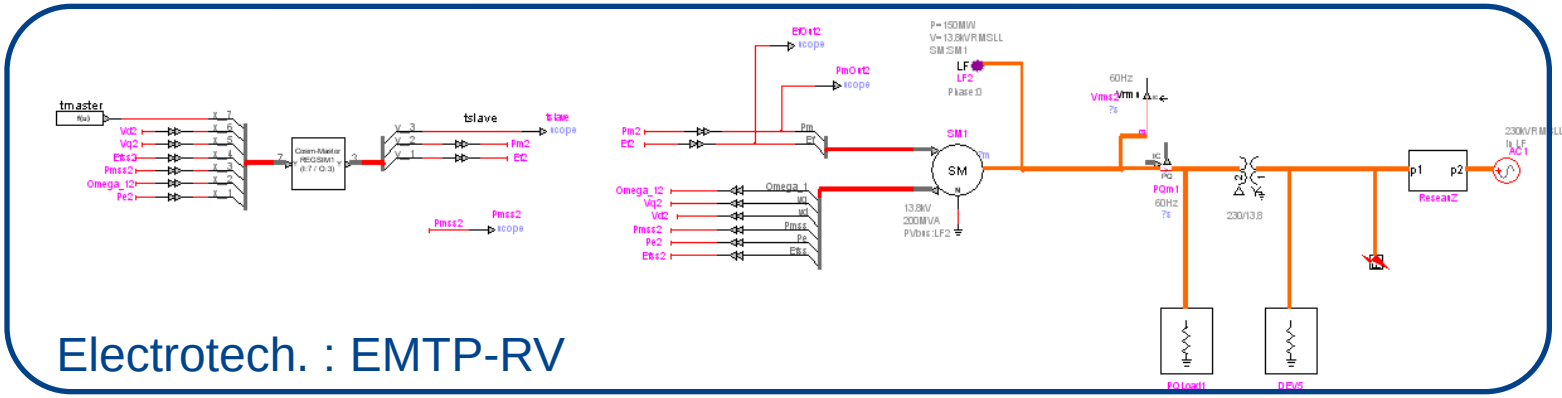

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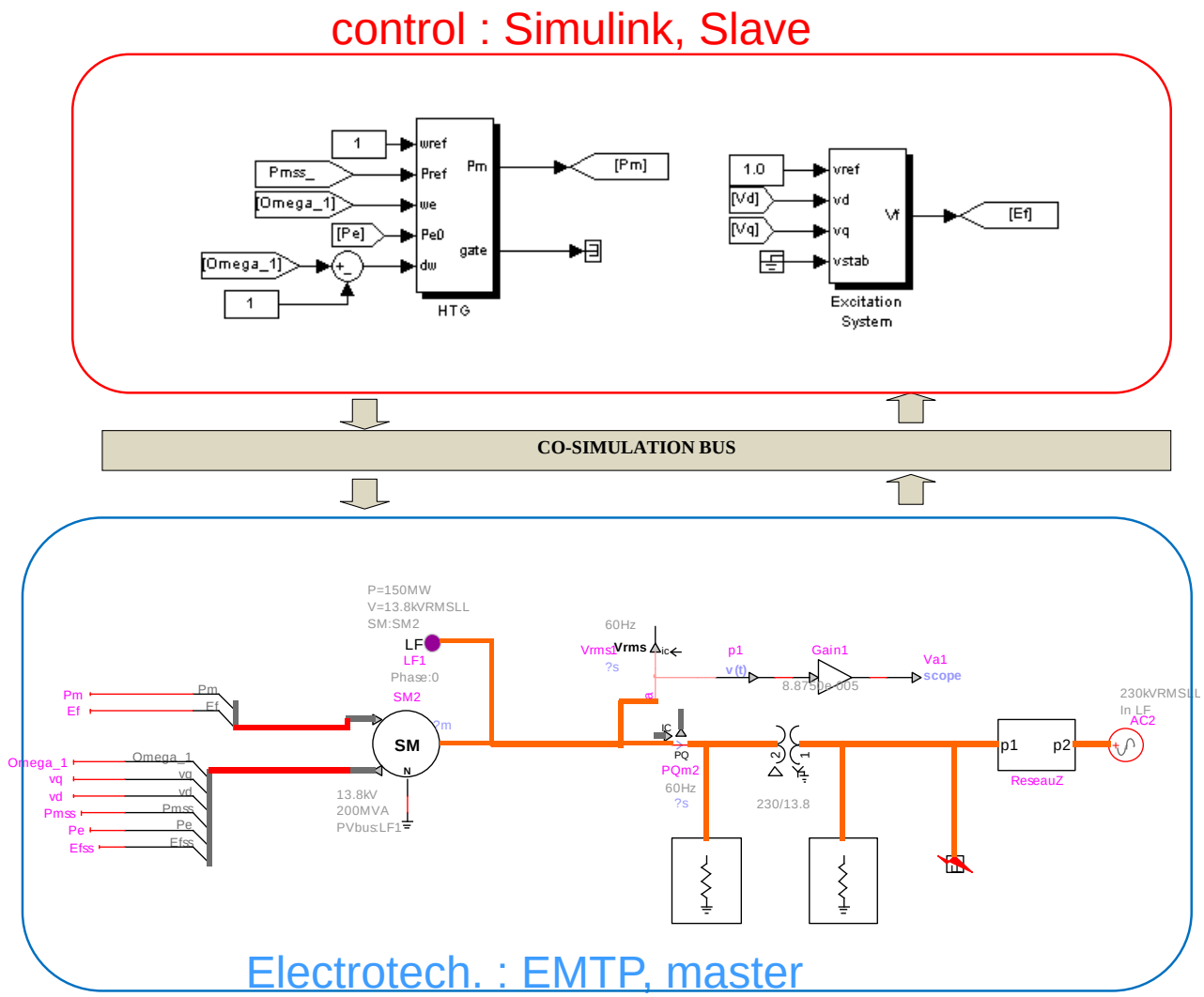

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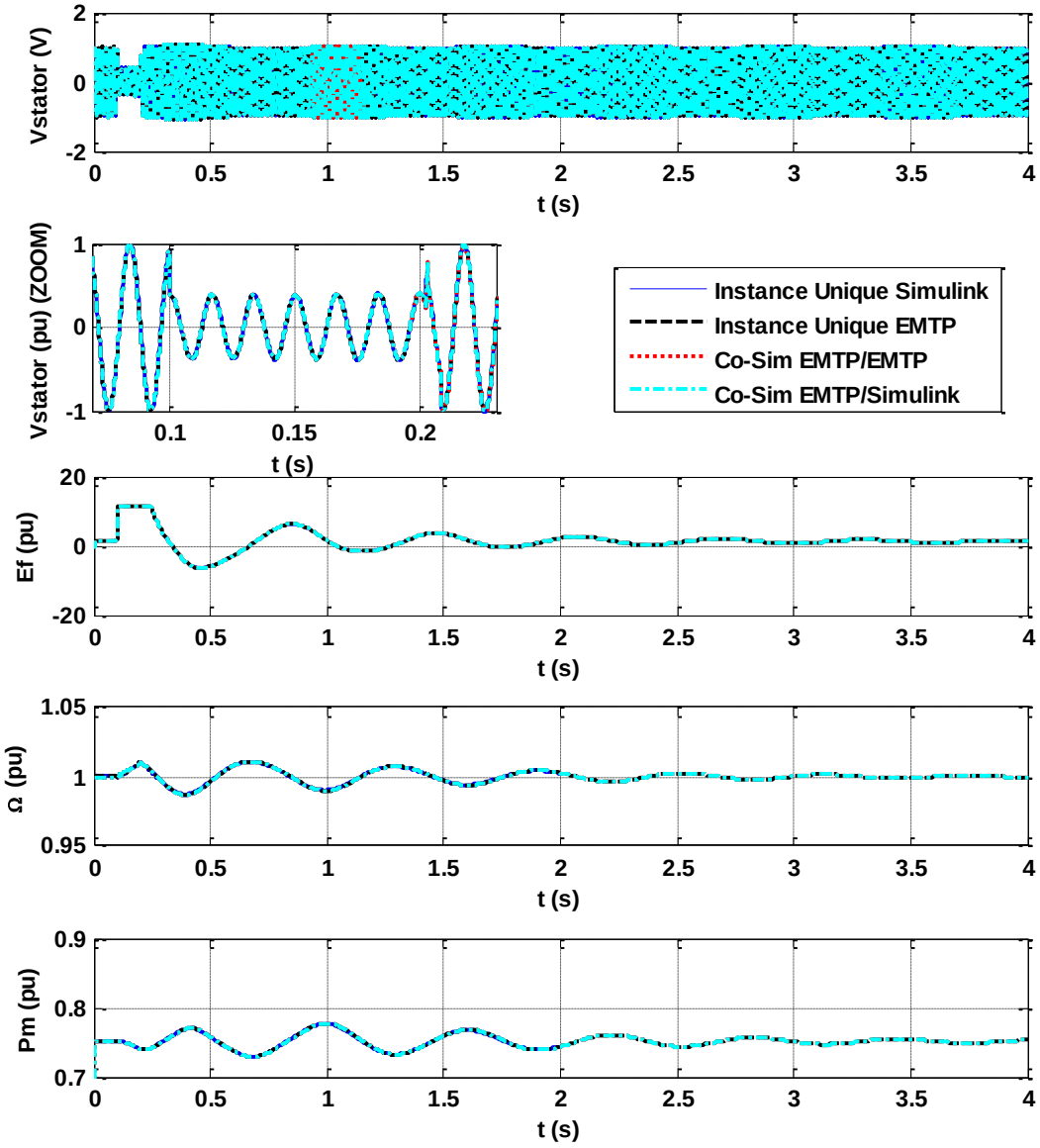

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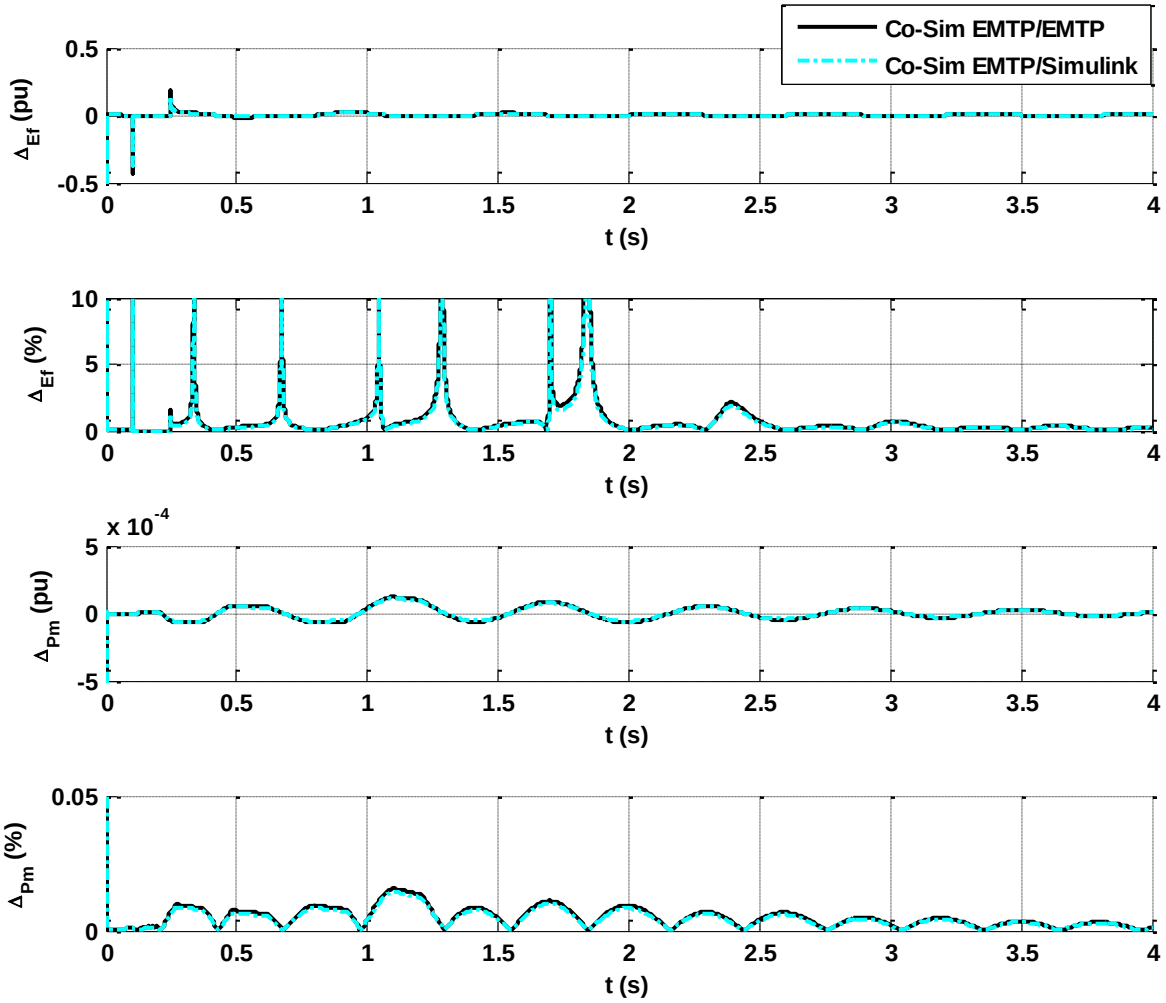

Conclusion

- Co-simulation bus (several EMTP-Rv instances, EMTP-Rv+Simulink …).

-Perspectives :

-Applications :
-smart grids (communication infrastructures dedicated tools)
-use cosimulation for paralelization
- Devt :
- Fmi standard;
- Windows / Linux co-simulation;
- Improve UI…
- Research :
- Advanced seynchrosim mecanisms (egs. : iterative approaches);
- Power signal exanges. (only control signals).
- Co-simulation with transient stability packages (phasor domain codes)…