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Assessment of power system dynamics: Demonstration of monitoring and control algorithms on a laboratory hardware emulator

MOTIVATION

The objective of this work is to develop a dynamic system emulator of the Kundur's Two-Area System, consisting of four generators and two weak tie-lines connecting two different areas.

With this emulator, analysis of oscillatory phenomena following negative events on the system: disconnection of tie-lines, sudden loss of loads and/or generation as well as disconnection of synchronous machine can be investigated

The setup allows the users to manipulate the value of the rotational inertia and to analyse different variables measured using Phasor Measurement Units (PMUs) as in the real field.

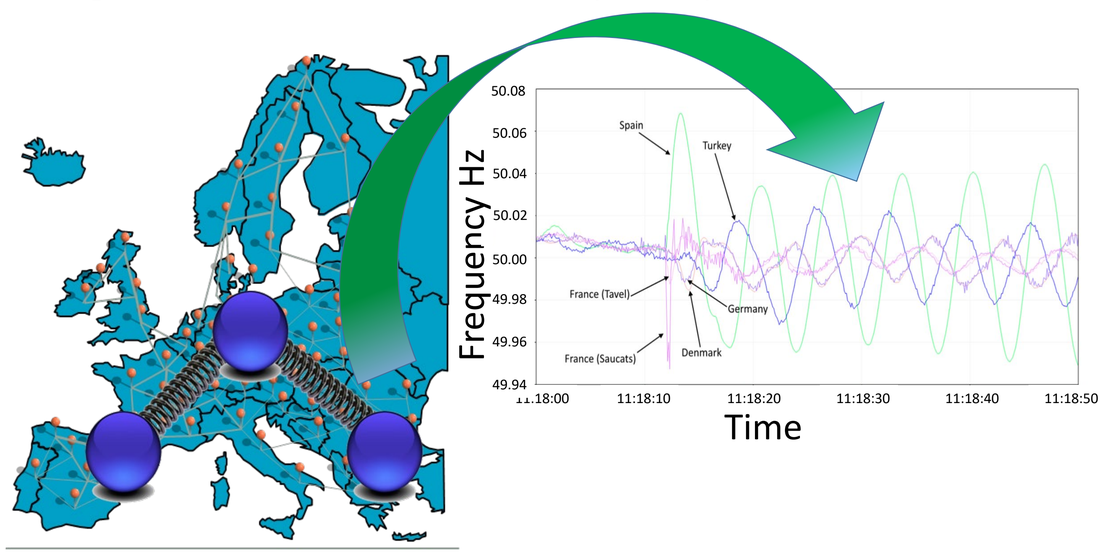


Fig. 1 Example of real oscillations in the European power system

EMULATOR DESCRIPTION

The single line diagram of the didactic transmission system model is depicted in the following figure:

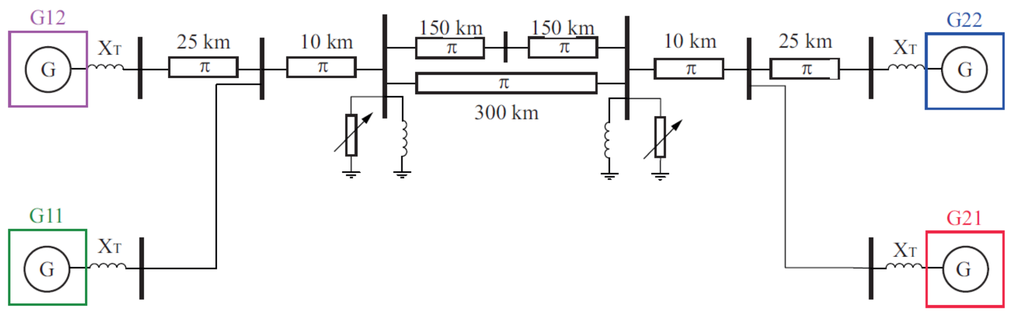


Fig. 2 Two-area system as depicted in the literature.

The real system, was assembled using commercial hardware from different vendors and actual synchronous generators. The system emulator allows the demonstration of developed control algorithms in a lab environment.

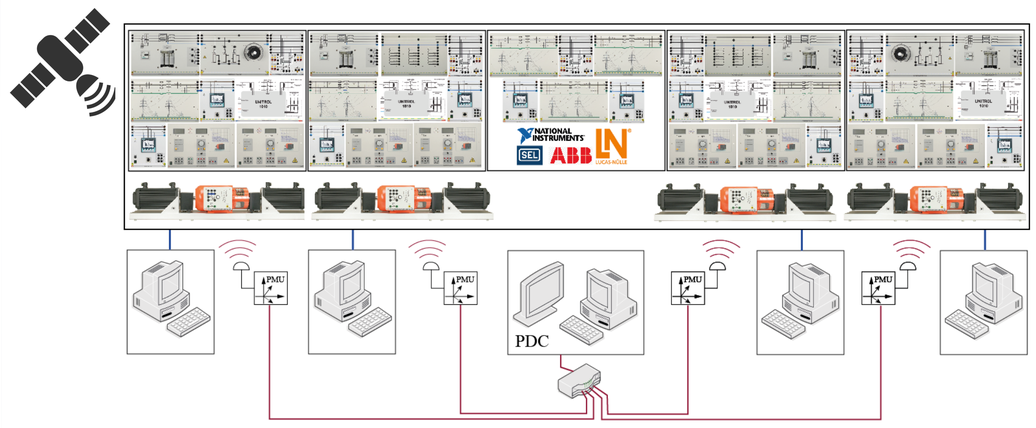
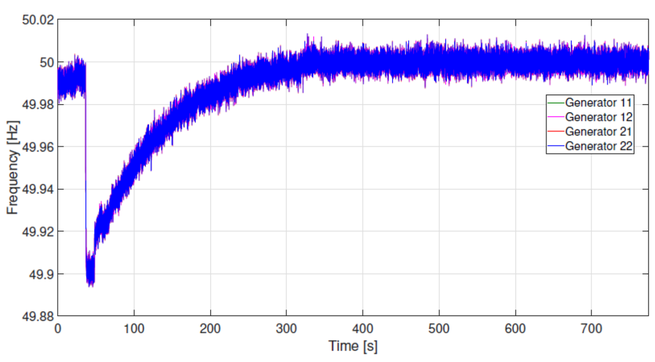


Fig. 3 Laboratory hardware emulator of the two-area system.

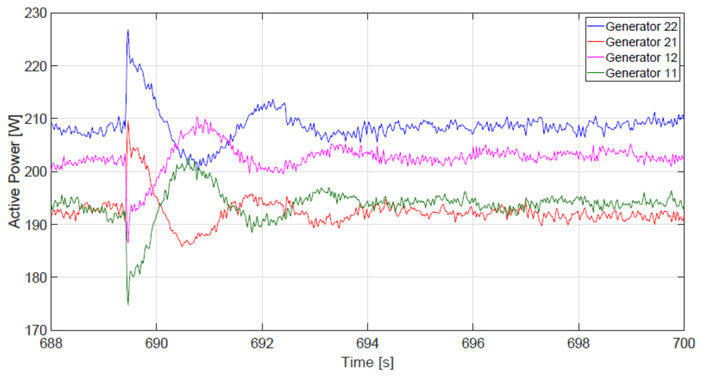
SIMULATION RESULTS

Load Variation without addition inertia



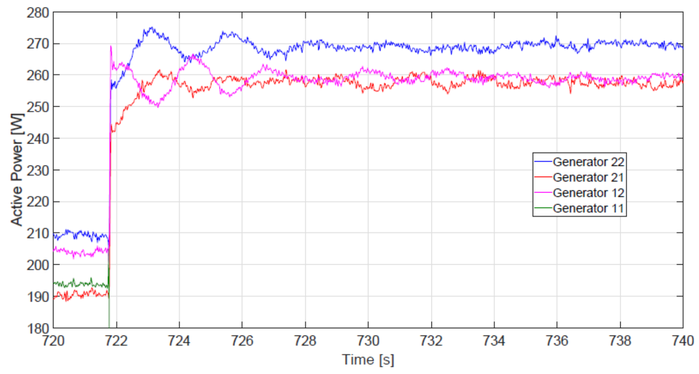
The frequency drops and all machines participate in primary frequency control to stabilize the frequency.

Line Tripping with additional inertia



After reconnection of the faulty line, the two generators in area one, swings against the machines in area two.

Tripping of one generator with additional inertia



After a generator trip in area one, the remaining machine swing against the generators in area two.

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zh aw School of Engineering

Research supported by:

SNSF, SCCER-FURIES, Swissgrid