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.

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

![Single Line Diagram]

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.

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.