Impact of the Exciter and Governor Parameters on Forced Oscillations

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INTRODUCTION AND BACKGROUND

- In power systems, forced oscillations within the low or ultra-frequency oscillations (LFO OR ULFO) are typically triggered by an external periodic disturbance from a cyclic load, equipment malfunction, inadequate control design, or mechanical oscillation of a generator under unusual operating conditions.
- These increasingly serious oscillations can damage equipment, restrict the ability to transfer power, and degrade the power quality.
- The parameters of exciters and governor models play a crucial role in defining the stability of the power system during disturbances. It is important to identify these models' sensitive parameters.

METHODOLOGY

- This study is conducted on Kundur's two-area system using PSS/E dynamic simulation tools.
- To simulate the forced oscillation event in the simulation model, a sinusoidal signal with a fixed frequency is introduced to the governor model's reference set point (G_{REF}) or exciter model's voltage reference set point (V_{REF}) of Generator–1 (G1) of kundur's system.
- The local oscillation frequency of 1.4Hz and an inter-area oscillation mode of 0.25Hz are considered.
- A 10MW (0.1 p.u., base = 100MW) peak-to-peak oscillations with constant magnitude and frequency were injected starting from 2 seconds as shown in Figure 1.
- SCRX, IEEE ST1A, and AC7B excitor models are studied. The SCRX block diagram is shown in Figure 2.
- The GAST, HYGOV, and GGOV1 governor models are studied.

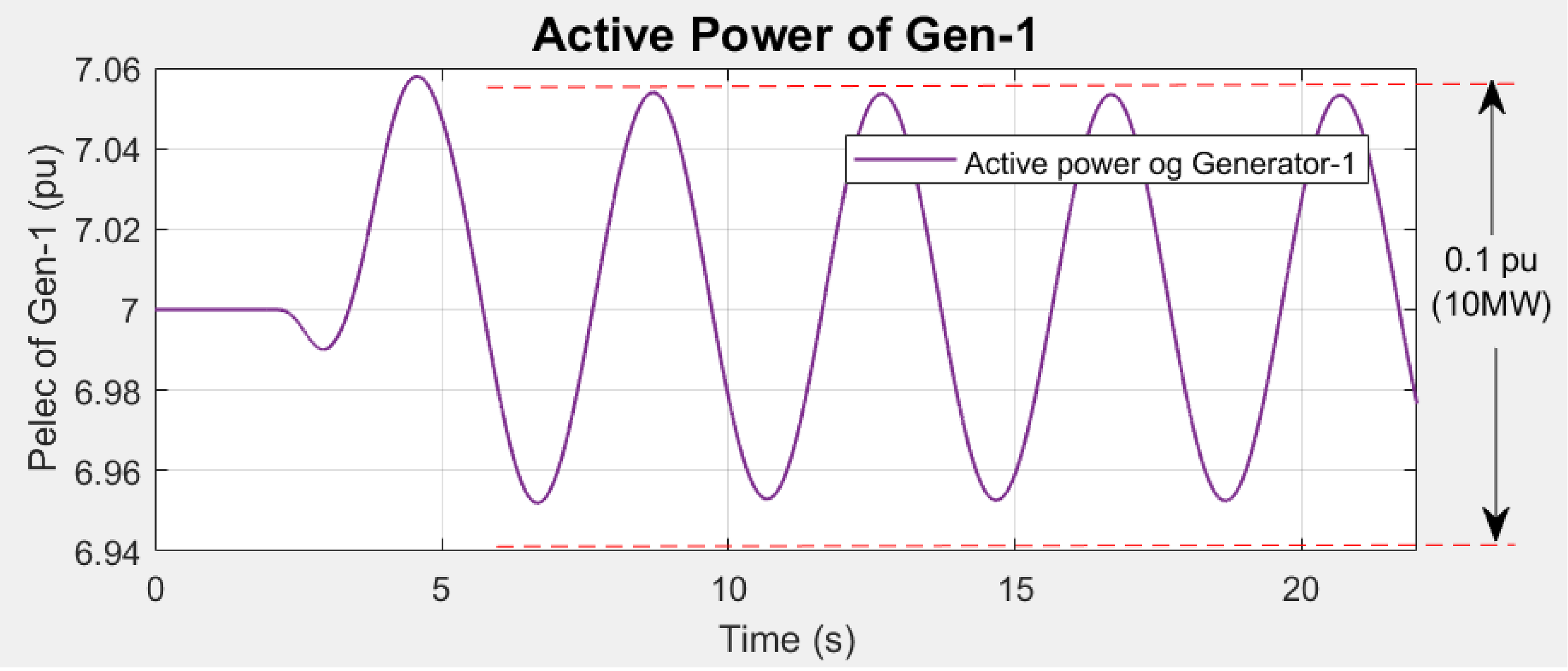

Figure 1. 10MW forced active oscillations of G1 with an oscillation frequency of 0.25Hz.

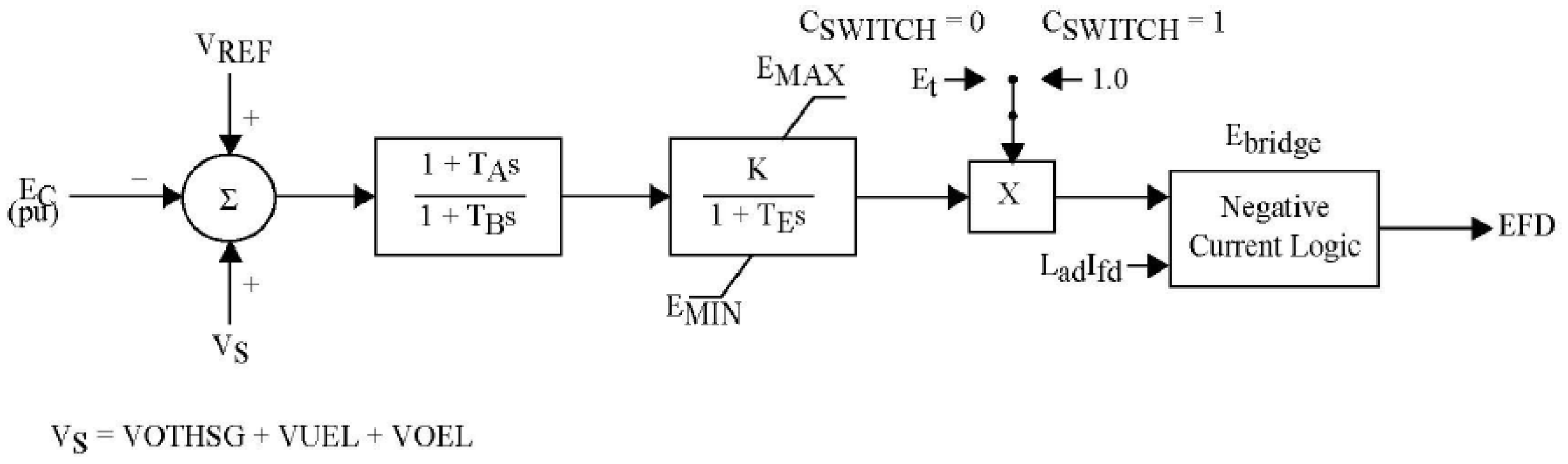

Figure 2. Block diagram of SCRX exciter model (Courtesy of Siemens PTI PSS®E).

RESULTS AND CONCLUSION

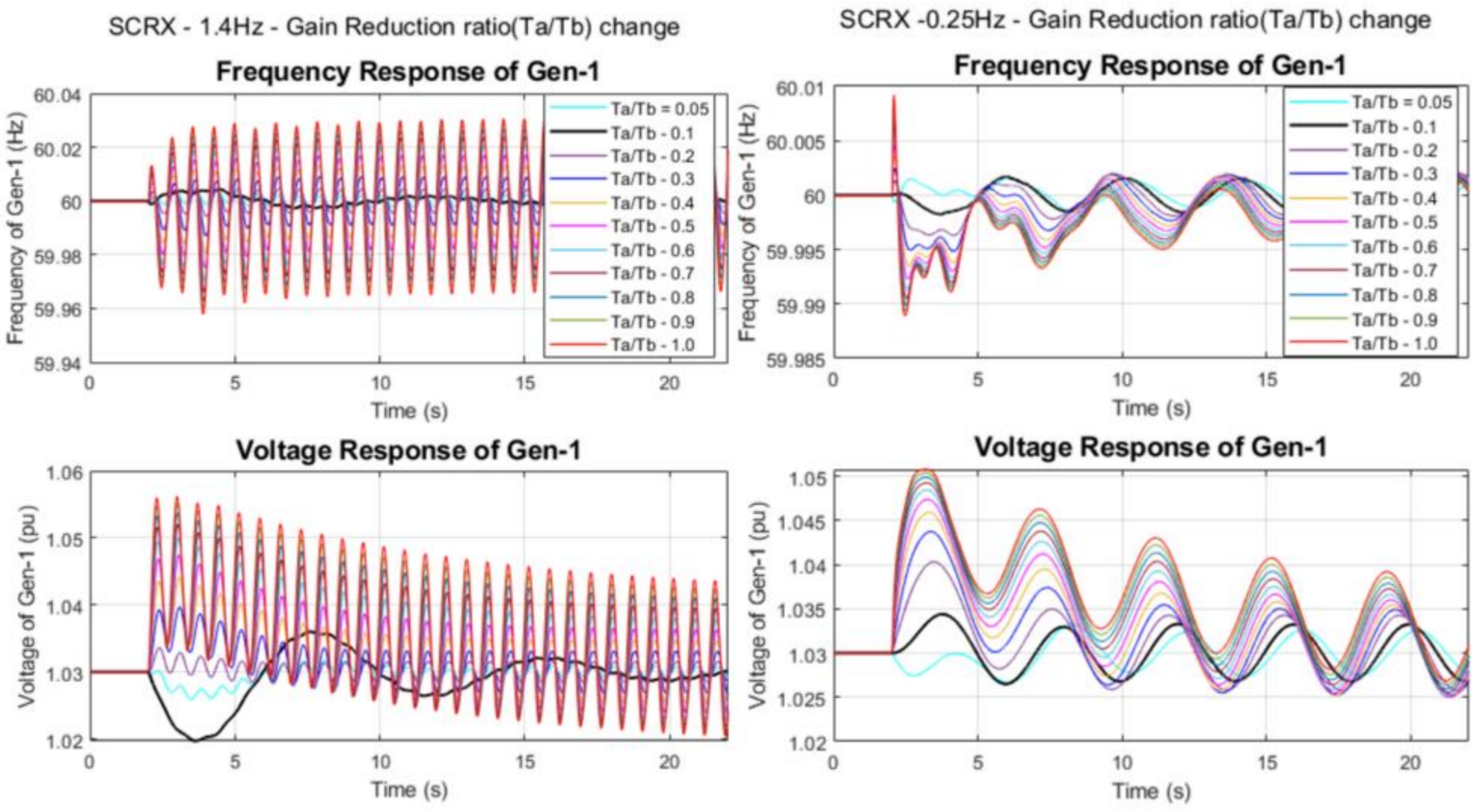

Figure 3. Response of SCRX gain reduction ratio (T_A/T_B) change

SCRX Parameters	Tested Parameters Range	Reactive Power Output (MVAR) 0.25Hz	1.4Hz	Rank
K – Exciter Gain	K – 100	10.012	10.043	1
	K – 1000	21.436	86.422	
T_A/T_B – Gain reduction ratio	Ta/Tb – 0.1	10.044	10.051	2
	Ta/Tb – 1.0	20.986	74.193	
T_E - Time constant	TE – 0.0	10.011	10.026	3
	TE – 1.0	0.601	0.859	
T_B – Time constant	Tb – 1.0	15.697	9.962	4
	Tb – 50.0	7.484	9.912	

Table 8. Sensitive Parameters of SCRX exciter with respective to reactive power change

- The sensitive parameters of the tested exciter and governor models, including input parameters of the model, are identified and ranked according to the severity of their influence on the forced oscillations.
- The gains of the excitor models and the turbine gains in the governor models are the most influential parameters.
- The malfunctioning of the control values of the model can also cause forced oscillations.
- The future work includes designing the governor and excitor models in PSCAD to test their influence.