

SAARC Training Workshop 'Power System Studies for Synchronization of Multiple Systems'

Excitation Systems Modeling in PSS/E

Day-3-C

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Excitation Systems

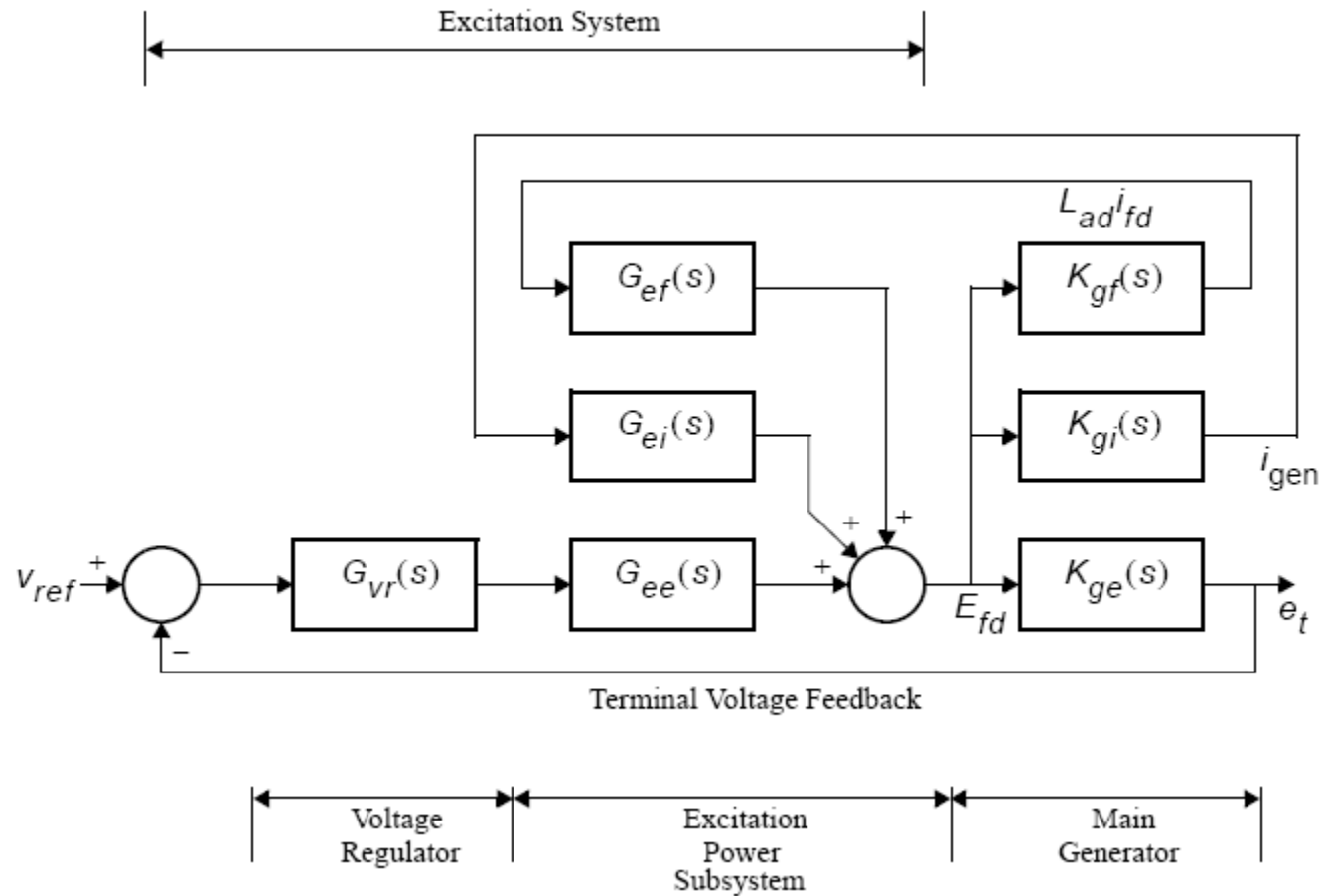
➤ The excitation system consists of

- high power source of direct current,
- intermediate power level controlling circuit
- instrument power level voltage regulator.

➤ The Voltage Regulator

- It determines the manipulation of the exciter, but its dynamics are often less influential than the nonlinear characteristics of the excitation power source in determining overall dynamic behavior of the system.
- The proper representation of excitation systems requires careful consideration of
 - both the gains and time constants assigned to the voltage regulators
 - the characteristics of the excitation power components.

Excitation Systems in Generating Units



Types of Excitation Systems in Generating Units

DC Exciters:

Utilize DC Generators as source of excitation power and provide current to the rotor through slip rings

AC Exciters:

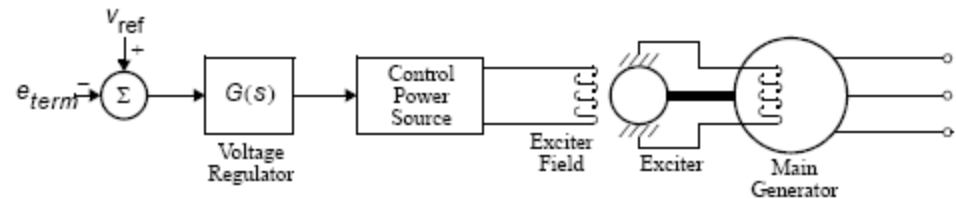
Utilize alternators (ac machine) as source of the main generator excitation system.

Usually the exciter is on the same shaft as the turbine generator
AC output of the exciter is rectified to produce DC needed for field winding. May be

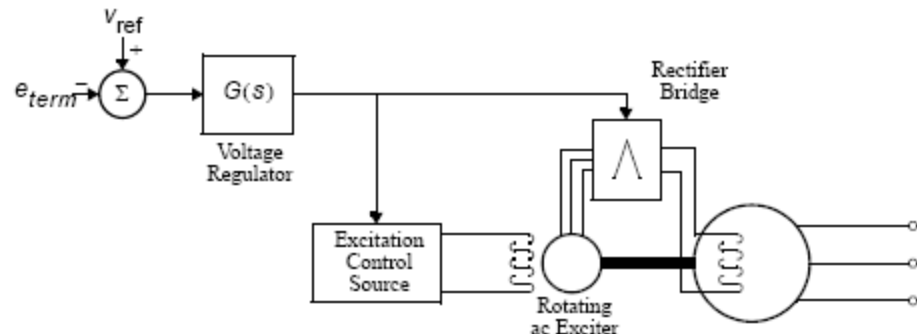
- Stationary feeding via slip rings
- Rotating (brushless)

Static Exciters:

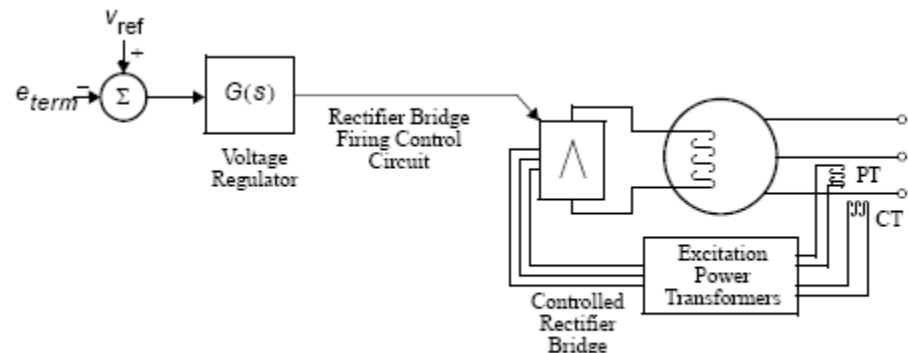
Supply of power to exciter is from main generator or station auxiliary
Feeds to field through slip rings



a. Rotating dc Exciter



b. Rotating ac



c. Excitation Power Fed from Generator Terminals

Control Block Diagram of Exciters

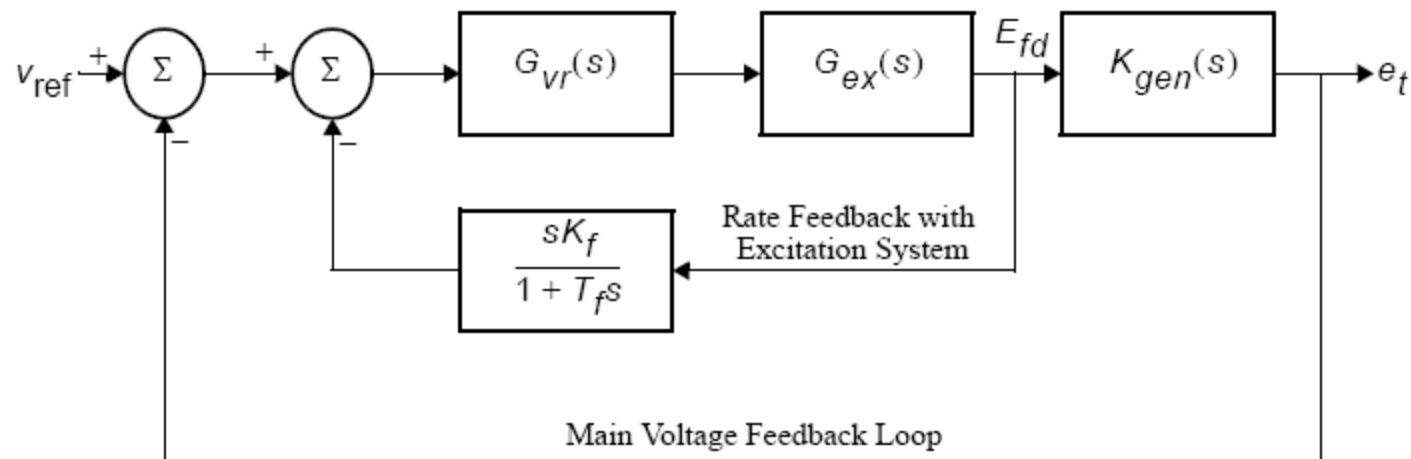


Figure 16-12. Use of Rate Feedback to Produce Transient Gain Reduction in Excitation System

The excitation system's overall transfer function includes both the dynamic characteristics of the exciter elements and the transfer function of the voltage regulator.

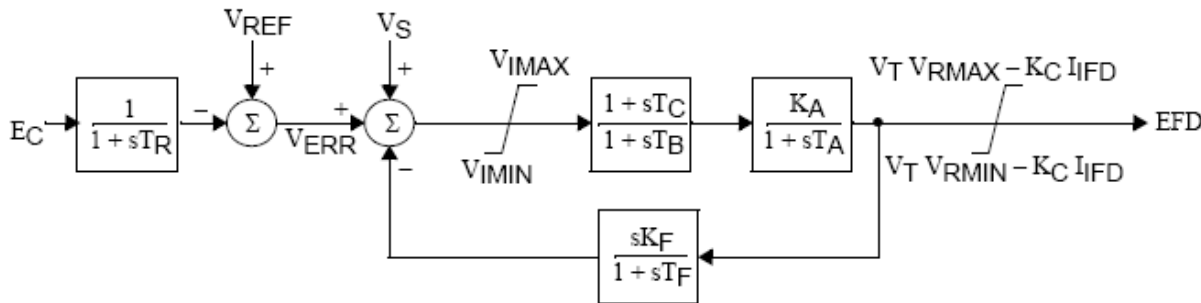
G_{vr} = Gain of Voltage Regulator

G_{ex} = Gain of Exciter (power amplifier)

K_{gen} = Gain of main generator

K_f = Gain of feedback loop

Exciter Model EXST1



$$V_S = V_{OTHSG} + V_{UEL} + V_{OEL}$$

CONs	#	Value	Description
J			T_R
J+1			V_{IMAX}
J+2			V_{IMIN}
J+3			T_C
J+4			T_B (sec)
J+5			K_A
J+6			T_A (sec)
J+7			V_{RMAX}
J+8			V_{RMIN}
J+9			K_C
J+10			K_F
J+11			T_F (> 0) (sec)

Excitation Systems in PSS/E Model Library

Models IEEET1, IEET1A, IEEEX1, and ESDC1A:

are widely used to represent systems with shunt dc exciters as well as systems with alternator exciters and uncontrolled shaft-mounted rectifier bridges.

Models IEEET2, IEEEX2, IEEX2A:

These models differ from IEEET1, etc., only in the source used for the excitation system stabilizing feedback. IEEET2 and IEEEX2 take this signal as proportional to the control element output, while IEEX2A takes this signal to be proportional to exciter field current.

Models IEEET3, IEEEX3

It differs only in the placement of the limit, VBMAX.

Models IEEET4, IEEEX4, IEEET5, IEET5A

It represent older excitation systems where the exciter is a dc machine and the voltage regulator is one of a wide variety of electromechanical devices

Models SEXS and REXSYS

Represents no specific type of excitation system, but rather the general characteristics of a wide variety of properly tuned excitation systems.

Model SCRX

It is also a general model, not tailored to the representation of any specific excitation system.

Excitation Systems in PSS/E Model Library, Contd.

Models EXDC2 and ESDC2A

differ from IEEEET1, etc. in only one aspect: the voltage regulator's source of supply is the generator or auxiliary bus voltage.

Models EXAC1 and ESAC1A

They emulate a field-controlled alternator rectifier excitation system consisting of an alternator main exciter with non controlled rectifiers.

Models EXAC2 and ESAC2A

They emulate a high initial response field controlled alternator-rectifier excitation system in which the alternator main exciter is used with non controlled rectifier.

Models EXAC3 and ESAC3A

They emulate a field controlled alternator-rectifier excitation system, which includes an alternator main exciter with non controlled rectifiers.

Models EXAC4 and ESAC4A

They emulate an alternator-supplied rectifier excitation system

Models EXST1 and ESST1A

They are intended to represent systems in which excitation power is supplied through a transformer from the generator terminals (or the unit's auxiliary bus) and is regulated by a controlled rectifier