Simplified 14-Generator Model of the SE Australian Power System

1 Contents of the Matlab state-space model and eigenanalysis result files

State-space models and associated eigenanalysis results are provided in Matlab compatible files. The files, in *.mat format, are read into Matlab using the "load" command. Their contents is described below.

Table 1 Contents of Matlab state-space model (ABCD matrix) files.

Identifier	Description	Units
AA BB CC DD	System state-space model matrices: A (NX x NX), B (NX x NU), C (NY x NX) & D (NY x NU) NX = total number of state-variables; NY = total number of outputs-variables; NU = total number of input-variables;	
D	D(i) = Machine damping torque coefficient of the i^{th} device. (Relevant only if DEVCAT(i) = 1).	pu on MBASE
DDT	Date stamp	
DEVCAT	Device category: DEVCAT(i) is the type of the i^{th} device: = 1 for a synchronous machine; = 2 for a SVC	
H	H(i) = inertia constant of the i^{th} device on its MVA base, MBASE(i). Relevant only if DEVCAT(i) = 1.	MWs/MVA
HEADER	(ignore)	
MBASE	MBASE(i) = MVA base of the the i^{th} device	MVA
MatrixTag	(ignore)	
ModelTag	(ignore)	
NUM	NUM(1) = NX; NUM(2) = NY; NUM(3) = NU;	
PNAME	Device names: PNAME(i,1:8) is the name of the i^{th} device.	
SBASE	System MVA base (100 MVA)	MVA
TIT1	Title, line 1	
TIT2	Title, line 2	
UN	Names of input variables (see Section 2): UN(i,1:13) is the name of the i^{th} input-variable, i = 1...NU	
XN	Names of state variables (see Section 2): XN(i,1:13) is the name of the i^{th} state-variable, i = 1...NX	
YN	Names of output variables (see Section 2): YN(i,1:13) is the name of the i^{th} output-variable, i = 1...NY	

Table 2 Contents of Matlab Eigenanalysis Result Files

Identifier	Description
E	Vector of eigenvalues (length NX)
EIGHED	(ignore)
P	Participation factor matrix (NX xNX): P(i,j) = participation factor of the i^{th} state-variable (X(i,:)) in the j^{th} eigenvalue (E(j)).
TIT1	Title, line 1
TIT2	Title, line 2
V	Matrix of right eigenvectors (NX x NX): V(:,j) is the right-eigenector of the j^{th} eigenvalue (E(j)).
W	Matrix of left eigenvectors (NX xNX) W(:,j) is the left-eigenvector of the j^{th} eigenvalue (E(j))
X	Names of state variables (see Section 2): X(i,1:13) is the name of the i^{th} state-variable, i = 1...NX

Note:

1. The eigenanalysis was conducted using the Mudpack package. If the user computes the eigenvalues and associated eigenvectors of the system state-matrix using the Matlab EIG function the ordering of eigenvalues is likely to be different from than that obtained by Mudpack. Consequently, a naive comparison of the eigenvalues calculated by Mudpack and Matlab, such as abs(E - eig(AA)) < tol, will most likely fail. Thus, to confirm consistency between the eigenanalysis results computed by Mudpack and Matlab, the Matlab the Matlab mfile “ConfirmEigenanalysis.m” is provided.
2. Mudpack uses the LAPACK subroutine DGEEV to calculate the eigenvalues with the default scaling factor of SCLFAC = 8 in DGEBAL. The Matlab EIG function also employs this subroutine, but with a scaling factor SCLFAC = 2. It is likely that small discrepancies between the eigenvalues obtained by Matlab and Mudpack may arise as a result of this difference.

2 Variable naming conventions

The state, input and output variables are named in accordance with the following pattern:

VVVV.DDDDDDDD

in which **VVVV** is the four character name of a variable and **DDDDDDDD** is the eight character name of the device (i.e. one of the names in the list of device names, PNAME, in the state-space model file.

Tables 3, 4 and 5 list the state-, output- and input-variable names used in the state-space model.

Table 3 State variable descriptions.

Variable Name	Description	Units
DEL	Rotor angle	rad.
W	Rotor speed	per unit of synchro-nous speed
Ed'	Voltage behind q-axis transient reactance	per unit
Eq'	Voltage behind d-axis transient reactance	per unit
Ed"	Voltage behind q-axis sub-transient reactance	per unit
FLkd	d-axis damper winding flux linkages	per unit
FLkq	q-axis damper winding flux linkages	per unit
EF[a]	Field voltage	per unit
VR, xnnn	State variables in AVR or PSS	per unit
B	SVC Susceptance	per unit
SV1	SVC AVR state	per unit

a. Base field voltage(current) is that field voltage (current) required to generate one per-unit stator voltage on the airgap line with the machine open circuit and rotating steadily at synchronous speed.

Table 4 Output variable descriptions.

Name	Description	Units
DEL	Rotor angle	rad
W	Rotor speed	per unit of synchro-nous speed
Vt	Generator or SVC terminal voltage	per unit
Vang	Generator or SVC terminal voltage angle	rad
P	Generator electrical power output	per unit on SBASE
Q	Generator or SVC reactive power output	per unit on SBASE
If	Generator field current	per unit
EF	Generator field voltage	per unit
I	SVC current magnitude	per unit
B	SVC Susceptance	per unit
Q/Vt	For an SVC the perturbation in the ratio of reactive power output to terminal voltage	per unit/per unit.

Table 5 Input variable descriptions.

Name	Description	Units
Vref	AVR voltage reference	per unit
Vs	Input corresponding to the point to which the PSS output will be connected.	per unit
Pm	Generator mechanical power	per unit on MBASE