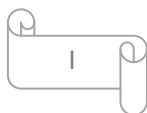


الآية

قال تعالى:

” أَمَّنْ هَذَا الَّذِي هُوَ جُنْدٌ لَكُمْ يَنْصُرُكُمْ مِّنْ دُونِ الرَّحْمَنِ إِنِ الْكَافِرُونَ إِلَّا فِي غُرُورٍ (٢٠)
أَمَّنْ هَذَا الَّذِي يَرْزُقُكُمْ إِنْ أَمْسَكَ رِزْقَهُ بَلْ لَجُّوا فِي عُتُوٍّ وَنُفُورٍ (٢١) أَفَمَنْ يَمْشِي
مُكِبًّا عَلَىٰ وَجْهِهِ أَهْدَىٰ أَمَّنْ يَمْشِي سَوِيًّا عَلَىٰ صِرَاطٍ مُّسْتَقِيمٍ (٢٢) قُلْ هُوَ الَّذِي
أَنْشَأَكُمْ وَجَعَلَ لَكُمُ السَّمْعَ وَالْأَبْصَارَ وَالْأَفْئِدَةَ قَلِيلًا مَّا تَشْكُرُونَ (٢٣)
قُلْ هُوَ الَّذِي ذَرَأَكُمْ فِي الْأَرْضِ وَإِلَيْهِ تُحْشَرُونَ (٢٤) وَيَقُولُونَ
مَتَىٰ هَذَا الْوَعْدُ إِنْ كُنْتُمْ صَادِقِينَ (٢٥) قُلْ إِنَّمَا الْعِلْمُ
عِنْدَ اللَّهِ وَإِنَّمَا أَنَا نَذِيرٌ مُّبِينٌ (٢٦) .“

المائدة (٢٠)-(٢٦)



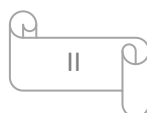
DEDICATION

To our parents who always inspiring and devising us, nothing of this could be done without them, may Allah saves them always.

To our dears, all of our family members who always be there when we need them.

To our best friends & colleagues who are always with us step by step, supports us to go forward.

To everyone who is an integral part of our support group, we dedicate this work.



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ABSTRACT

Stability study is the most important issue in power system; which keep the system secure and continuous operation. Stability of power system means the ability of the synchronous generators to be in synchronism when small or large disturbances occur in load or network of power system. If one of the generators losses the synchronism the other generators will be overloaded, which in turn leads to system separation and in worst case to blackout.

This project concerned to study and analyzes the small signal and transient stability problem for multi machines system. The nonlinear equations which represent the system have been linearized, then state space model is derived in order to study and analysis the dynamic performance of the system. The two area system (four machines-ten busbars system) has been taken as case study. The AVR system causes negative damping of oscillation; so that the PSS was designed and added in optimal location by using participation factor technique to increase the damping ratio. The eignvalue analysis and time domain simulation are carried out to analyze the system stability; finally the responses and results have been represented for several cases by using time domain simulation.

المستخلص

إستقرارية النظام من أهم الدراسات في منظومة القدرة الكهربائية، حيث تحافظ على أمن النظام وإستمرارية الخدمة، والمقصود بإستقرارية منظومة القدرة الكهربائية مقدره الآلات المتزامنة بها على الإحتفاظ بتزامنها بعد أي تغيير يحدث تدريجياً او فجائياً لشبكة او أحمال منظومة القدرة . عند فقد أحد المولدات للتزامن يحصل تحميل زائد لبقية المولدات مما يؤدي الي إنقطاع كامل للكهرباء وخروج الشبكة من الخدمة لذا يجب حل ومعالجة مشكلة عدم الإستقرارية بسرعة.

هذا المشروع يهتم بدراسة وتحليل الإستقرارية لنظام متعدد الماكينات تحت تأثير التغيرات الطفيفة والتغيرات العابرة. حيث تم تمثيل النظام في صورة معادلات تفاضلية غير خطية ثم تحويلها إلي معادلات خطية ،ومن ثم تم إستقاق نموذج فراغ الحالة من أجل تحليل الاداء الديناميكي للنظام. ولغرض الدراسة أخذنا نظام يتكون من أربعة ماكينات وعشرة قضبان تجميع بالإضافة إلي نظام متحكم الجهد الأتوماتيكي. و بما أن نظام متحكم الجهد الأتوماتيكي يسبب اخماداً سالباً للتذبذبات التي تحصل نتيجة للتغيرات الطفيفة في المنظومة مثل تغيير الحمل، أو التغيرات العابرة مثل الأعطال تم تصميم مثبت نظام القدرة الكهربائية وإضافته في الموقع المناسب بإستخدام تقنية معامل الإشتراك أو المساهمة وذلك لزيادة نسبة التخميد. ثم حلت إستقرارية النظام عن طريق نظريتي أقطاب معادلة الخصائص، و نظام المحاكاة في حيز الزمن. واخيراً عرضت الإستجابات والنتائج لعدد من التغيرات والإضطرابات التي تحدث للنظام وتمثيلها في نظام المحاكاة الزمني.

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LIST OF SYMBOLS

E_q'	q-axis component of the transient internal emf proportional to the field winding flux linkages.
E_q''	q-axis component of the subtransient internal emf proportional to the total flux linkages in the d-axis damper winding and the field winding.
E_{fd}	Generator field voltage
E_d'	d-axis component of the transient internal emf proportional to flux linkages in the q-axis solid steel rotor body
E_d''	d-axis component of the subtransient internal emf proportional to the total flux linkages in the q-axis damper winding and q-axis solid steel rotor body
δ	Rotor angle
ω_i	Rotor speed
H	Inertia constant
D	Damping coefficient
T_{do}'	open-circuit d-axis transient time constants
T_{do}''	open-circuit d-axis subtransient time constants
T_{qo}'	open-circuit q-axis transient time constants
T_{qo}''	open-circuit q-axis subtransient time constants
λ	flux linkage
J	moment of inertia
T_m	The mechanical torque applied to the shaft
T_e	The Electrical torque
T_{fw}	The damping torque coefficient
θ	Rotor angular displacement

v_{fdi}	the field voltage
i_{fdi}	the field current
r_{fdi}	the resistance current
ψ_{fdi}	flux components in the dq0 reference system
$v_{Di}, v_{Qi} \& v_{Oi}$	the stator voltage in the dq0 reference system
$i_{Di}, i_{Qi} \& i_{Oi}$	the stator current in the dq0 reference system
$\psi_{Di}, \psi_{Qi} \& \psi_{Oi}$	the stator flux linkage in the dq0 reference system
r_{si}	the stator resistance
x_{Di}, x_{Qi}	d & q-axis reactance
x_{di}', x_{qi}'	d & q-axis transient reactance
V_t	The terminal voltage
V_∞	Infinite bus voltage
ΔP_e	Electrical power deviation
G_w	Washout stage transfer function
$G(s)$	Lead-lag transfer function
K_{pss}	Power system stabilizer gain
T_w	Washout time constant
ζ	Damping ratio
ω_n	Un-damped natural frequency
K_A	Automatic voltage regulator gain
T_A	Automatic voltage regulator time constant
T_1, T_2, T_3, T_4	Power system stabilizer time constants

LIST OF ABBREVIATIONS

AC	Alternating Current
DC	Direct Current
AVR	Automatic Voltage Regulator
PSS	Power System Stabilizer
HVDC	High Voltage Direct Current
SMIB	Single Machine Infinite Bus
GEPS	Generator, Exciter system, and power system
PF	Participation Factor
PSO	Particle Swarm Optimization
MOHBMO	Multi-Objective Honey Bee Mating Optimization
GA	Genetic Algorithm
FACTS	Flexible Alternating Current Transmission System