Identification of Coherent Generators for Large-Scale Power Systems Using Fuzzy Algorithm

MAHDI M. M. El-ARINI
Electrical Power System
Zagazig University
Zagazig, Elsharkia
EGYPT
elarinimm@yahoo.com

AHMED FATHY
Electrical Power System
Zagazig University
Zagazig, Elsharkia
EGYPT
ahmed_fathy_1984@yahoo.com

Abstract: - This paper presents a new proposed method for identifying the coherent groups of generators for any large power system, this is based on two different techniques; the first one is based on applying two proposed coherency criterions introduced by using time response of the linearized power system model; the second one is based on the application of Fuzzy C-Means clustering algorithm (FCM). Also a new technique of constructing the dynamic equivalent of power system is presented in this work. The proposed method is applied on two different power systems. The obtained results proved that the proposed technique is highly effective in determining the coherent groups of generators and in constructing the dynamic equivalent of power system with high accuracy.

Key-Words: - Coherent groups of generator, Fuzzy C-Means Clustering Algorithm, Dynamic equivalents, Network reduction, Dynamic aggregation, Large-scale power system.

1 Introduction

Because modern power systems are so large, power system analysis programs do not usually model the complete system in detail [1]. This problem of modeling a large system arises for a number of reasons including: Practical limitations on the size of computer memory, the excessive computing time required by large power systems; particularly when running dynamic simulation and stability programs, parts of the system far away from a disturbance have little effect on the system dynamics and it is therefore unnecessary to model them with great accuracy, often parts of large interconnected systems belong to different utilities, each having its own control centre which treats the other parts of the system as external subsystems, finally Even assuming that full system data are available, maintaining the relevant databases would be very difficult and expensive. The computational time can be reduced if the transient stability is determined in a reduced order equivalent model of the original system. In order to overcome all these problems, power system can be divided to two parts one of them is called the internal subsystem, or the study system which is modeled in detail. The remainder of the system, called the external system, is represented by simple models referred to as the equivalent subsystem or simply as the equivalent. The internal subsystem includes the disturbance and a small number of generators of great concern. These generators are severely disturbed and are in general responsible for the system instability. The system states like voltage, current, angle and speed of these generators are very important for control and protection purposes. The rest of generators are considered in the external system. The generators in the external system do not contribute significantly to the system instability. Thus the dynamic equivalencing technique is applied to these generators only. Fig. 1 illustrates such division.

In [7] the power system division is based on that the generators close to fault have a tendency accelerate much faster than the generators away from the disturbance.