

## بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

( أَنْزَلَ مِنَ السَّمَاءِ مَاءً فَسَالَتْ أَوْدِيَةٌ بِقَدَرِهَا فَاحْتَمَلَ السَّيْلُ زَبَدًا رَابِيًا وَمِمَّا يُوقِدُونَ عَلَيْهِ فِي النَّارِ ابْتِغَاءَ حُلْيَةٍ أَوْ مَتَاعٍ زَبَدٌ مِثْلُهٗ كَذَٰلِكَ يَضْرِبُ اللَّهُ الْحَقَّ وَالْبَاطِلَ فَأَمَّا الزَّبَدُ فَيَذْهَبُ جُفَاءً وَأَمَّا مَا يَنْفَعُ النَّاسَ فَيَمْكُثُ فِي الْأَرْضِ كَذَٰلِكَ يَضْرِبُ اللَّهُ الْأَمْثَالَ "17")

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صَدَقَ اللَّهُ الْعَظِيمُ

# *Dedication*

*To my family with all the love,*

*my Brothers, and sisters with all the love,*

*and with my respect..*

## *Acknowledgements*

*Foremost, I would like to express my deep thanks and great appreciation to my supervisor Dr. Awadalla Taifour for support, guidance throughout this research. Finally, I would like to thank all my teachers and my colleagues in SETCo.*

# Abstract

Modern power systems networks consist of a number of utilities interconnected networks together. Power is exchanged between utilities over tie-lines by which they are connected. Automatic Generation Control (AGC) plays a very important role in power system. It's main role is to maintain the system frequency and tie-line flow at their scheduled values during normal period and also when the system is subjected to small step load perturbations.

Fuzzy logic has been successfully applied to a large number of control systems applications. The most commonly used controller is the Proportional Integral Derivative (PID) controller, which requires a mathematical model of the system. A fuzzy logic controller provides an alternative to the PID controller. It is a good tool for the control of systems that are difficult to model.

In this study, a power system with two areas connected through tie-line is considered. The objective of AGC, based on fuzzy PID controller, is to damp the transient deviations (frequency and power) and to provide zero steady-state error of these variables in a very short time. The simulation is implemented by using MATLAB/SIMULINK program.

## مستخلص

تحتوي نظم القدرة الكهربائية الحديثة علي عدد من الشبكات الكهربائية ترتبط مع بعضها البعض ، تتبادل الطاقة الكهربائية عن طريق خطوط الربط الكهربائي. يلعب التحكم الآلي للتوليد دورا رئيسيا في تثبيت التردد للنظام الكهربائي وكذلك انسياب القدرة خلال خط الربط الكهربائي بالقيم المبرمجة أثناء دورة التشغيل العادية وأيضا خلال اهتزازات الحمل الكهربائي الخفيفة.

أصبح التحكم المنطقي الغامض يطبق بنجاح في عدد كبير من التطبيقات ومن أكثرها استخداما المتحكم المنطقي التناسبي- التكامل-التفاضلي الغامض الذي صار بديلا للمتحكم التناسبي- التفاضلي- التكامل الذي يتطلب نمودجا رياضيا للنظام. ويعتبر أداة جيدة للتحكم للأنظمة التي يصعب وضع نموذج رياضي لها.

في هذه الدراسة، أخذ في الاعتبار نظام قدرة كهربائي يتألف من نظامي قدرة كهربائية يتكونان من منطقتين ترتبطان عن طريق خط ربط كهربائي. الغرض من استخدام التحكم الآلي للتوليد- الذي يعتمد علي ( المتحكم التناسبي-التكامل-التفاضلي الغامض)- هو اخمد الانحرافات العابرة للتردد والقدرة وكذلك أن يعطي هذا المتحكم خطأ صفري للحالة المستقرة لهذه المتغيرات في زمن وجيز. تم عمل المحاكاة والتحليل باستخدام برنامج (ماتلاب) عن طريق برنامج رابط المحاكاة.

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## **Abbreviations**

|      |                                        |
|------|----------------------------------------|
| ACE  | Area Control Error                     |
| AC   | Alternating Current                    |
| AGC  | Automatic Generation Control           |
| CCD  | Charged Coupled Device                 |
| D    | Derivative                             |
| DC   | Direct Current                         |
| FP   | Fuzzy Proportional                     |
| FPD  | Fuzzy Proportional Derivative          |
| FPID | Fuzzy Proportional Integral Derivative |
| FLC  | Fuzzy Logic Controller                 |
| I    | Integral                               |
| LFC  | Load Frequency Control                 |
| MHD  | Magneto-Hydro-Dynamic                  |
| NB   | Negative Big                           |
| NS   | Negative Small                         |
| P    | Proportional                           |
| PB   | Positive Big                           |
| PS   | Positive Small                         |
| PV   | Process Variable                       |
| SP   | Set Point                              |
| Z    | Zero                                   |