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ELEKTRON

TRANSFORMING HUMANITY THROUGH TECHNOLOGY

A Publication of Department of Electrical Engineering
University of Engineering and Technology, Lahore.

Message From The Vice Chancellor

“

University of Engineering and Technology is an institution which has always nurtured its students to set and achieve lofty goals by provideing them the freedom to polish their skill set thriugh curricular and co-curricular activities. A commendable product of such efforts and skills is Elektron, a magazine by the Department of Electrical Engineering, produced by the student chapter of IEEE, UET Lahore. Elektron reflects the creative minds of the students of Electrical Engineering and their abilities to breathe life into their innovative ideas.

To make this magazine a constant source of guidance and inspiration for the masses, the work done by the team Elektron is indeed worthy of appreciation. The efforts put forth by the team Elektron should serve as a motivation for other students of UET Lahore to embark upon similar initiatives.I wish them best in their future endeavors.

”

Prof. Dr. Syed Mansoor Anwar

Vice Chancellor,

University of Engineering & Technology, Lahore

Message From the Chairman

The aphorism “publish or perish” asserts the importance of publishing the scholarly work by the faculty and students. The Department of Electrical Engineering, historically, has been highly reputed for its outstanding undergraduate program. It has never been more important to involve undergraduate students in research. To publish the work carried out by undergraduates has always been a challenge, due to the lack of availability of proper forum of this purpose, This is no more a limitation due to the introduction of Elektron magazine. The IEEE UET Lahore team has put an extensive effort to make the idea a realization. Elektron provides an excellent opportunity to both undergraduate as well as graduate students to publish their work. I believe this initiative will go a long way and will be pivotal in defining the careers of many.

Prof. Dr. Muhammad Tahir

Chairman, Department of Electrical Engineering

University of Engineering & Technology, Lahore

Message From the Editor in Chief

“

In Pakistan, the students at the pre university level are often curious about opting their areas of professional education. However, it is observed that the students at those levels do not have access to the relevant knowledge to help make their minds taking suitable decision.

Electron magazine is an effort of the department of electrical engineering of UET Lahore, to remove this knowledge deficit of the pre university students. Specially, this magazine is an attempt to provide some knowledge to both the foundations and advances of the domain of science and engineering, in general and electrical engineering and its applications, in particular. Link among religion, philosophy and science is another relevant area of study, published under the scope of this magazine.

Other than helping pre university students, Elektron is also publishing articles to enhance the knowledge of early semester students of electrical engineering, professional scientists, engineers, specially, electrical engineers, and of the other readers interested in learning and knowing about foundations and advances of science and engineering.

This issue of electron invited the articles with very broad scope, but the preferred areas of interest for this issue were, but not limited to

- Religion and Science
- Contribution of Muslims in the Field of Science
- Science and Philosophy (a union)
- Technical Innovations in Electrical and Electronics Engineering
- Engineering Mathematics
- Engineering Protocols and Ethics
- Engineering Book Reviews
- Works of a Renowned Researcher
- Engineering Case Studies

In this issue, we have included two sections to appreciate our alumni and also our current students.

1. Alumni Achievement
2. Skills of Our Student

Through these two sections, our aim is to introduce our readers to the immense potential of our Alumni and also our currently registered students. I hope, this issue of Elektron will also gain your attention and appreciation.

”

Dr. Muhammad Salman Fakhar
Editor In Chief (faculty)
Lecturer, Department of Electrical Engineering
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MS Student EE Department 2021

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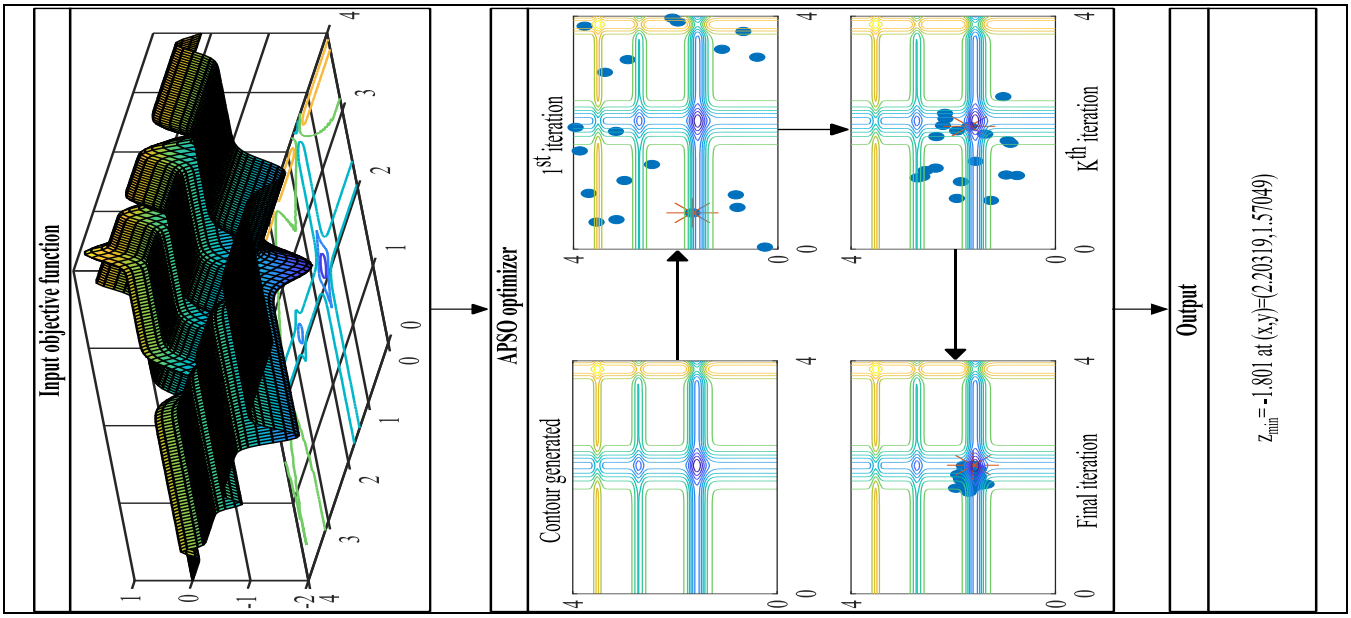
وَعِنْدَهٗ مَفَاتِحُ الْغَيْبِ لَا يَعْلَمُهَآ اِلَّا هُوَ ؕ وَيَعْلَمُ مَا فِى الْبَرِّ وَالْبَحْرِ ؕ وَمَا تَسْقُطُ مِنْ وَّرَقَةٍ
اِلَّا يَعْلَمُهَا وَلَا حَبَّةٍ فِىْ ظُلُمٰتِ الْاَرْضِ وَلَا رَطْبٍ وَّلَا يَابِسٍ اِلَّا فِىْ كِتٰبٍ مُّبِيْنٍ ﴿6:59﴾

(6:59) He has the keys to the realm that lies beyond the reach of human perception; none knows them but He. And He knows what is on the land and in the sea; there is not a leaf which falls that He does not know about and there is not a grain in the darkness of the earth or anything green or dry which has not been recorded in a Clear Book.



Metaheuristic Optimization. An active and important research tool in Power Systems Optimization

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Abstract: Power systems' operation and control is a very important dimension of power systems' research and studies. It deals with the optimization problems of power systems, starting from the generation side to the end consumer of electricity, which is operational. In operational research, the optimization being solved are non-linear, multi-modal, and multi-dimensional in nature, for which it is difficult to find the ultimate optima and the demand remains alive to find the better and better solution to that problem. Conventional numerical methods and optimization techniques, which are mostly deterministic in nature, mostly remained failed to solve such problems. Metaheuristic algorithms, like swarm intelligence algorithms, and evolutionary algorithms, having both deterministic and stochastic approaches, perform better in solving such problems. This article presents to the new researchers an introduction to the applications of metaheuristic algorithms in power systems and the possible avenues of doing research in this field.

Keywords: Metaheuristic algorithms, power systems' operation, and control, power system optimization

1. Introduction

Power Systems' operation and control have been a very important domain of power systems studies as it helps not only help in operating the power systems at their optimum limits but also can help in giving insights for the future planning of it. The operation, control, and planning perspectives of the power system are relevant to all the parts of the power system, i.e., generation, transmission, distribution, and utilization [1]. The problems, that are discussed in this domain are usually non-linear, multi-modal, and multi-dimensional in nature and they fall under the category of operational research. In operational research, it is difficult to find the exact optima of an optimization problem and it is mostly demanded to find better and better nears of the ultimate optimum solution.

Numerical methods or conventional optimization algorithms like NR methods, bound and search methods, and Gauss-Seidel methods, are deterministic in nature and are also dependent upon the initial estimates of the solution space. Being only deterministic, they stick to a local optimum solution which is not required in a multi-modal optimization problem. The initialization of the starting solutions is itself an open-to-solve optimization problem, as without having a good initial guess, the deterministic methods converge towards local solutions also. Metaheuristic methods, which are deterministic as well as stochastic in nature are therefore well suited to solve the power systems optimization problems of such nature [2]. This article is an attempt to introduce new researchers to the active research areas in this domain and guide them to give them insight.

2. Power System Optimization Problems

Being a researcher in the domain of power systems optimization, it is firstly required to get acquainted with the knowledge of types and classifications of the problems, discussed in this domain. The following are a few of several types of problems that are usually discussed in this domain of research [1].

- **Economic dispatch problem** – the operation of the generators connected to a bus in a power system on such values of power, at which the overall operation cost (dependent upon the fuel consumed) is minimized.
- **Emission dispatch problem** – the operation of the generators connected to a bus in a power system on such values of power, at which the carbon, sulfur, and nitrogen emissions are minimized.
- **Combined economic and emission dispatch** – a multi-objective optimization problem discussing simultaneously the economic dispatch and emission dispatch problems.
- **Unit commitment problem** – a problem that deals with deciding the appropriate generating units to supply the load demand on a power system bus.
- **Optimal Power Flow Problem –** a problem that combines a power flow study with an economic dispatch problem is known as the Optimal Power Flow problem.
- **Optimal sizing of FACTs devices –** a problem that deals with the decision of MVAR injection of leading or lagging VARs and then finding the optimal magnitude of those VARs is known as Optimal sizing of the FACTs devices problem.

Battery's State of charge optimization – a problem that deals with the optimal charging of the battery while dealing with several constraints of the battery and the constraints of the charging system.

3. Metaheuristic Optimization Algorithms in Power System Optimization

As discussed earlier, power systems optimization problems are usually non-convex, non-linear optimization problems and are usually NP-hard in nature, i.e., they are not guaranteed to converge to the ultimate best solution in polynomial time. Conventional algorithms like Newton Raphson, Gauss-Seidel, and Gradient search methods remain ineffective in finding good approximates of the global optimum results of these problems. This is mainly because of the deterministic nature of these algorithms, which leads them to converge to the local optimum solutions.

Metaheuristic algorithms, on the other hand, are an amalgam of both the deterministic and stochastic approaches with enhanced advantage of good exploration and exploitation strategies to hunt well the good approximate to the global optimum solutions of the complex power system optimization problems. Following are some of the well-known metaheuristic optimization algorithms [3].

- Particle Swarm Optimization
- Genetic algorithm
- Evolutionary algorithm
- Grey Wolf algorithm
- Firefly algorithm
- Cuckoo search algorithm
- Flower pollination algorithm
- Dragonfly algorithm
- Whale optimization algorithm

The mentioned names are the canonical versions of these algorithms. Depending upon the requirements and

landscape of the optimization problem, the algorithms may be chosen and applied in their canonical versions, or their variants may also be developed to increase the efficiency of these algorithms [3].

4. Scope of Dimensions of Research in this Area

The two straightforward avenues of research in this area are

1. to apply existing metaheuristic algorithms and their existing variants on the unsolved and open-to-solve power system optimization problems while keeping in view the advancements in the mathematical model of the problem models. These demands discussing the complexities of the optimization problems by touching the complex constraints, that make the problem near to realistic actual problems.
2. To find and design new variants of the existing algorithms or to make new metaheuristic algorithms inspired by natural phenomena and then applying on the old unsolved or new optimization problems of the power system. This approach of research in this domain is more inclined towards being a mathematician to design good optimization techniques by deploying the mathematical aspects and models.

5. Conclusion

This article was an attempt to give a generic overview of the research domains of power systems optimization. The new researchers and students may get an overview of this research domain and may get a good starting point to continue in this research area.

6. Reference

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This picture is taken from "https://www.pexels.com/photo/illuminated-computer-screen-4509131/"

An Overview of Kotlin

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A**bstract**: This article has been written after research from credible sources and it is intended to introduce students to the Kotlin language. The preferred language in android development is Kotlin. Around 60 applications of Google have been written in Kotlin e.g. Maps and Drive. It is estimated by Google that around 1000 of the top apps on the play store are written in this language. Therefore, it is worthwhile to be at least familiar with it. This study gives an overview of the Kotlin Language. [1][2]

Keywords: OOP-Object Oriented Programming

1. Introduction

Kotlin is a static type, OOP language which can fully interoperate with Java. It is preferred by Google and android developers as it is lightweight and its code is simpler and more concise. From variable declarations to class method extensions, this language is far simpler to handle than Java. **[1]**

2. Java vs Kotlin

Java is used for android development and for other purposes e.g. in embedded systems and web applications but kotlin is more suited than Java for android development because of the following reasons:

1. **Jetpack composes** (Android's newly introduced toolkit for building static layouts and the interactive user interface) can **only** be used in **kotlin**. Where in java, the user interface is made with **XML (Extensible Markup Language)** which is crucial for android developers to have a grip on as it is used in the manifest file, string.xml, and important files in android development. However, it is less preferred than jetpack

composes because the former has more features and allows to build more with less code. Students are encouraged to explore more on jetpack compose as they'll understand the advantage of using compose over XML. **[1][4]**

2. As Kotlin is preferred by Google for android development, more features have been introduced to it e.g. being able to **extend** methods and properties of a class. By extension, inheritance is not meant. Students are encouraged to explore more on kotlin's additional features.**[1]**

3. The coding convention of kotlin is easier than that of java. For e.g. no semi-colons are required at the end of every line of code and data types of properties and variables don't have to be declared.

   Java is great for development purposes and it crucial to have a good understanding of it. Also, it can interoperate with kotlin. However, the purpose of the above-mentioned discussion is to emphasize that it's worthwhile to at least explore kotlin.

3. Platforms for Learning

Many platforms are available for learning kotlin. Some of them are given below:

1. https://developer.android.com/
2. https://www.coursera.org/
3. https://kotlinlang.org/
4. https://www.udemy.com/

4. Introductory Concepts

Kotlin has two types of variable declaration. In the **"Val"** type of variable, the value can't be changed after storing. In the **"var"** type, the value can be changed after storing it in it. Kotlin has the following data types:

1. Int
2. Float
3. Double
4. String
5. Boolean

Figure 1: Basic variable declarations and data types
Source: My code is written on Kotlinplayground

5. Classes, Objects & OOP

A **class** is a blueprint for an object and has three parts:

1. Constructor
2. Properties
3. Methods

While the **object** is the instance of that class.

The pillars of OOP are:

1. **Inheritance** which is denoted by IS-A relation between a superclass and one or more subclasses.
2. **Polymorphism** which can be seen between subclasses of the same superclass.
3. **Encapsulation** is done to reveal as much information as is necessary and it can be done by visibility modifiers which are given below:
   - **Public** (code logic is visible everywhere)
   - **Internal** (code can only be accessed within the same package)
   - **Protected** (code can be accessed by a class and its subclasses)
   - **Private** (code can only be accessed by a class)

6. Abstraction

Abstraction is an extended concept of encapsulation in which the basic idea is to hide the logic of one component from the other one. A real-life example is taking pictures from a camera i.e. while taking pictures, one does not know what is going on inside the camera.**[1]**

7. Composition

which is denoted by HAS-A relation between classes.

```
//Internal shows the level of encapsulation i.e. all classes,objects,functions will
//remain inside the package.
internal open class UET(val Type : Int){

 //open keyword indicates that inheritance can be done from the class/property/method
 open val department : String= "Any"
     get()=field


 open fun studenttype(){
      var a = when(Type){
          1 -> "Undergraduate Student"
          2 -> "Post Graduate Student"
          else -> "Alumnus/Faculty"
      }

      println("Type of Student is $a of UET.")
  }
}
```

```
//EE(subclass) has IS-A (inheritance from UET(superclass))
internal class EE(val stutype : Int) :
      UET (Type = stutype)     {

   override val department : String= "Electrical"
    get()=field

    val coursecodes="EE___"

 //override keyword indicates that the method of superclass will be overridden
 //that of subclass will be called. To call method of superclass after overridi
 //from subclass..use the 'super' keyword.
    override fun studenttype(){
      var a = when(Type){
          1 -> "Undergraduate Student"     //conditional statement..though if/e
          2 -> "Post Graduate Student"     //statements are also present in Kot
          else -> "Alumnus/Faculty"
      }

      println("Type of Student is $a of $department Department.")
  }

}
```

```
//studenttype() method of both subclasses of UET are polymorphs.

//CS(subclass) has IS-A (inheritance from UET(superclass))
internal class CS(val stutype : Int) :
      UET (Type = stutype)     {

   override val department : String= "Computer Science"
    get()=field

  val coursecodes= "CS___"

    override fun studenttype(){
      var a = when(Type){
          1 -> "Undergraduate Student"
          2 -> "Post Graduate Student"
          else -> "Alumnus/Faculty"
      }

      println("Type of Student is $a of $department Department.")
  }

}
```

```
/*Example of Composition(HAS-A Relation) as Teacher teaches student in EE
department and teacher teaches student in CS department.*/
internal class Teacher (val depone : EE , val deptwo : CS) {

    val name = "Sir!"

    fun teaches(){
        depone.studenttype()
        deptwo.studenttype()
    }

}

//name is input parameter with type String and the function return type is String
fun printinfo(name:String):String{

    val a = "Name of Student is $name."    //prints name of student
    return a

}
```

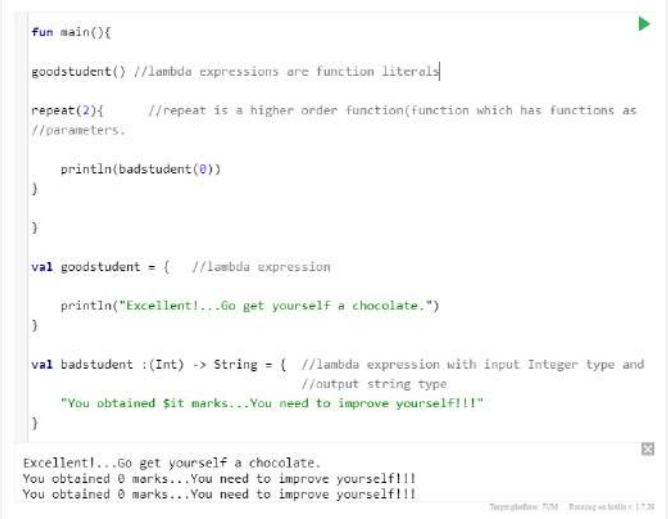
```
fun main() {
    println("Hello, We'll learn about OOP concepts implemented in Kotlin :-) ")
    println()
    val record1= UET(1)              //record1 is object of class UET
    record1.studenttype()            //method of UET has been called
    println(printinfo("Ahmed"))      //function printinfo has been called
    println()

    val record2=CS(2)               //record2 is object of class CS
    record2.studenttype()           //method of CS has been called
    println(printinfo("Shoaib"))    //function printinfo has been called
    println()

    val record3=EE(3)              //record3 is object of EE
    record3.studenttype()          //method of EE has been called
    println(printinfo("Fatima"))   //function printinfo has been called
    println()

    //Important Observation regarding Polymorphism!!!
    println("\"studenttype() method of both subclasses of UET are polymorphs.\"")

    println()
    val teacher = Teacher(EE(1),CS(1))        //object of class Teacher
    //Property of Teacher has been called
    println("Name of teacher is ${teacher.name}.")
    teacher.teaches()   //method of Teacher has been called
}
```

```
Hello, We'll learn about OOP concepts implemented in Kotlin :-)

Type of Student is Undergraduate Student of UET.
Name of Student is Ahmed.

Type of Student is Post Graduate Student of Computer Science Department.
Name of Student is Shoaib.

Type of Student is Alumnus/Faculty of Electrical Department.
Name of Student is Fatima.

"studenttype() method of both subclasses of UET are polymorphs."

Name of teacher is Sir!.
Type of Student is Undergraduate Student of Electrical Department.
Type of Student is Undergraduate Student of Computer Science Department.
```

Figure (2-7): Elaboration of OOP concepts in Kotlin
Source: My code is written on Kotlinplayground

8. Lambda Expressions

Lambda expressions are function literals. As the name suggests, they are like methods but they don't need a name. Lambda expressions are widely used in android development, especially Kotlin.



```
fun main(){

goodstudent() //lambda expressions are function literals

repeat(2){      //repeat is a higher order function(function which has functions as
//parameters.

    println(badstudent(0))
}

}

val goodstudent = {   //lambda expression

    println("Excellent!...Go get yourself a chocolate.")
}

val badstudent :(Int) -> String = {  //lambda expression with input Integer type and
                                     //output string type
    "You obtained $it marks...You need to improve yourself!!!"
}
```

```
Excellent!...Go get yourself a chocolate.
You obtained 0 marks...You need to improve yourself!!!
You obtained 0 marks...You need to improve yourself!!!
```

Figure 8: Demonstration of Lambda Expressions in Kotlin
Source: My Code is written in Kotlinplayground

9. Generics & Higher Order Functions

Generics and higher-order functions greatly simplify the code. Higher-order functions are functions whose parameters are other functions. Some higher-order functions used in Kotlin are:

1. map( )
2. filter( )
3. fold( )
4. groupBy( )

10. Collections In Kotlin

Kotlin has many collections such as Array, List, Sets, and Map Collection. The concept of array, list, and the set is pretty similar to that in other languages such as python. Map Collection comprises key-value pairs. This concept will be cleared by the following image: [1]

```
fun main(){
 val progress = Exemprogress().apply {   //apply is also a higher function which
 //allows to access the class method without using the object's name with . notation.
     printInfo()
  }
}

data class Exam <T>(            //Generic class as type can be String/Boolean/Int etc
   val name: String ,           /*class has no methods...it has only data so
                                  it is a data class*/
   val Type: T
)

class Exemprogress{
    val a = Exam <String> ("Essay","written")        //object of class Exam
    val b = Exam <Boolean> ("multiple choice",true)

   fun printinfo(){ a.let{
        println(it.name)
        println(it.Type)                //let() is a higher order function which
        //allows to access object's components without using the variable name
        //repeatedly.it keyword is an implicit declaration in kotlin
        println()
    }

     b.let{
        println(it.name)
        println(it.Type)
    }
   }
}
```

```
Essay
written

multiple choice
true
```

Figure 9: Demonstration of Generics and higher-order functions
Source: My Code is written in Kotlinplayground

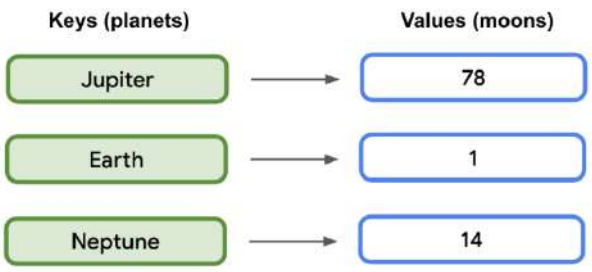


Figure 10: Key-value pairs in Map Collections
Source: https://developer.android.com/codelabs/basic-android-kotlin-compose-collections/

11. Conclusion

Learning Kotlin opens an array of opportunities. It is widely used in android applications and mobile software development. If someone is already skilled in languages like Java and python, learning kotlin will give them an edge. It is worthwhile that students to learn and explore this language.

12. References

[1]. “Android Basics with Compose”
Available:
https://developer.android.com/courses/android-basics-compose/course/

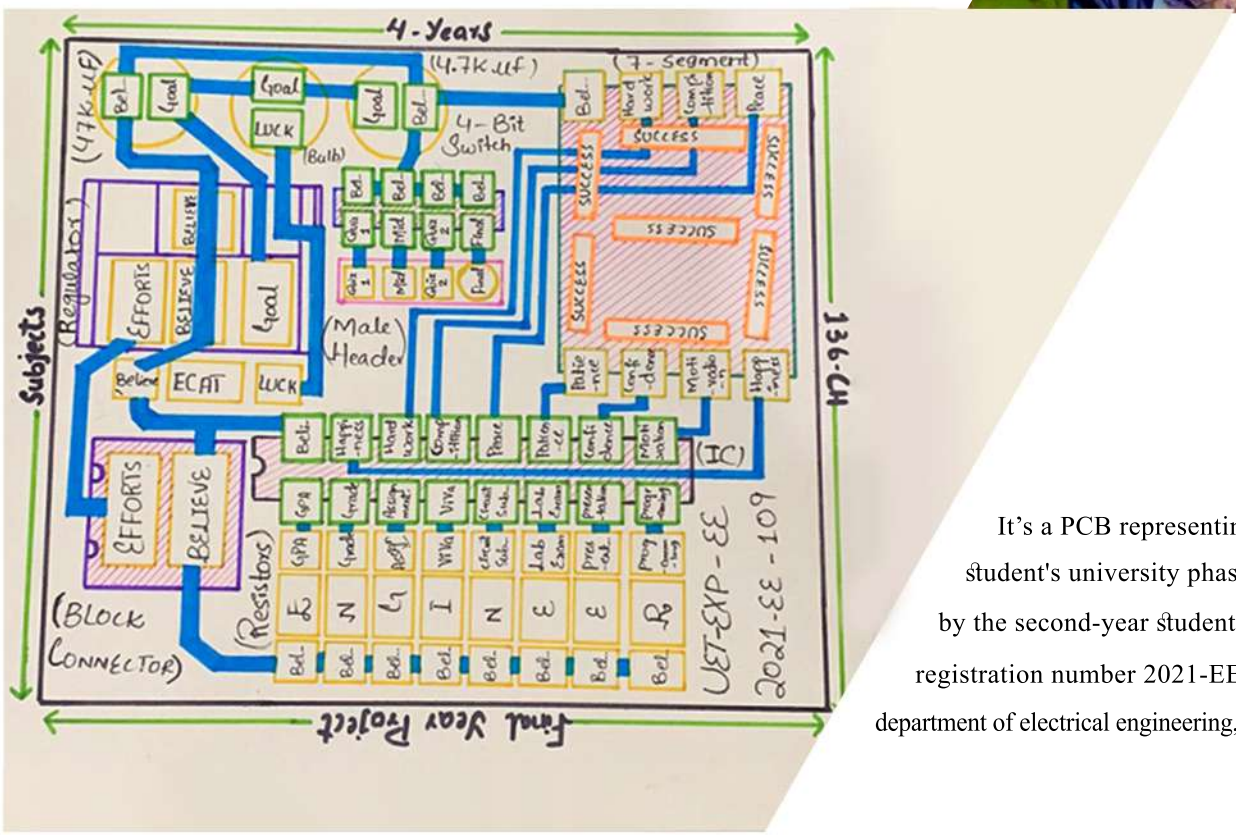
[2]“Use classes and Objects in Kotlin”,
Available:
https://developer.android.com/codelabs/basic-android-kotlin-compose-classes-and-objects/

[3] ” Develop Android apps with Kotlin”
Available:
https://developer.android.com/kotlin/

[4] “Java Programming: Complete Beginner to Advance”
Available:
https://www.udemy.com/course/java-programming complete-beginner-to-advanced/

[Accessed: Oct 15, 2022]

PCB of Engineering Student's Life at UET



It's a PCB representing every EE student's university phase, designed by the second-year student Iqra Bhatti, registration number 2021-EE-109, of the department of electrical engineering, UET Lahore.

Starting with block connecter, it has two connections: ground = believe and input = efforts. These connections continue to a 3-connection regulator; its output is "goal".

The ECAT SMD resistance has "belief" and luck as "ends". Making it through the admissions process, the bulb lights up confirming our power section is working fine

Now comes the real deal; the quizzes and exams are the switches attached to the male headers. The circuit will be tested for four years by different instructors using these headers and switches. The 8-bit IC is connected to many resistances. From maintaining a CGPA to struggles in social life, the students must overcome them with patience, confidence, and motivation to complete our circuit's connection all the way to success.

As Sir, Arslan A. Rahim always says to fill and thicken the ground and input. The students need to have a strong belief in Allah and themselves, and with constant efforts only then a circuit of our life will work.

This picture is taken from "https://www.pexels.com/photo/colorful-high-voltage-power-transformer-7867328/"

Analysis and Improvement Measures of Acetylene Gas in Converter Transformer

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Abstract: After ± 660kV converter station was put into operation, Acetylene gas was reported in the online oil chromatography of the converter transformer. After a half year of operation, the acetylene content of the converter transformer was 1.31ppm. It exceeded the alarm value of 1ppm. The excessive acetylene gas in the oil interferes with the operation state analysis of the converter transformer. By analyzing the gas production mechanism of the tap changer switch, it is found that the polar switch produces acetylene gas. After the actual tracking verification, it is found that reducing the tap changer polar switch action could effectively reduce the acetylene content. This paper proposes the influence of the tap changer switch on acetylene content and countermeasures to provide a reference for the operational analysis of the converter transformer.

Keywords: Converter Transformer, Acetylene, Tap Changer Switch, Online Monitoring

1. Introduction

In HVDC systems, the Converter transformer is the key equipment connecting to the AC-DC system, and its transformer oil operation performance is crucial.[1] In general, because of the local heating of the winding, internal abnormal discharge and load tap switch oil chamber leakage will lead to transformer insulation oil deterioration.

Once the oil chromatography acetylene of the transformer body exceeds the standard, it indicates that there is a fault inside the converter transformer compressor, and the power failure should be checked and handled in time. Currently, oil testing is carried out through online monitoring device and offline insulation oil tests. It is found that a trace amount of acetylene appears in each converter transformer. The management personnel of the converter. Station Engineers deeply focused on it and studied the principle of the converter transformer.

Shanghai Jiaotong University of state grid corporation of China regarding the converter transformer operation situation, introduces the typical faults in the converter operation, including the power protection error, high acetylene content, joint inconsistency, and treatment measures to ensure the normal operation of the converter transformer [1].

China state grid corporation found a converter transformer acetylene problem, studied a based on oil chromatography detection, high-frequency local discharge detection, high-frequency local discharge detection, and ultrasonic local discharge detection joint detection technology, can efficiently and accurately find out the number of converter transformer fault, fault type and fault parts[2]

In 2005, acetylene was found in the oil chromatography test of ± 500kV Jiangling converter station in China, Hubei Electric Power Research Institute analyzed this anomaly. Passed the no-load voltage (1 ~ 31,32 ~ 1) Check, after the system debugging, all the goose converter stations appeared 0.3-0.4 L / L acetylene, which is similar to the converter transformer of ± 660kV Lahore converter station[3].

In 2013, North China Electric Power University specially tested a converter transformer used in an HVDC project, and found that acetylene was generated inside the converter transformer after the polar switch operation of the tap changer. In the normal operation of the converter transformer, the gas in the oil will produce acetylene. The converter transformer load tap changer switch (polar switch action) puts forward the inspection method and improvement measures, to improve the accurate judgment of the fault state of the converter transformer compressor, and provides a powerful reference for the analysis of the converter transformer operating state [4]. The Yunnan-Guangdong ± 800kV UHVDC project put into operation in 2009, and the China Southern Power Grid UHV Transmission Company found different degrees of acetylene gas in converter transformers. After analysis, the root cause is the instantaneous potential suspension of the voltage regulating coil during the normal operation of the load tap switch polar converter, and the spark discharge of the capacitor current [5].

In 2010, North East China Power Grid Company found that in DC power transmission engineering ± 500 kV Yimin Yi Mu Jia (Huliao). Pole I DC converter transformer (YD coupling) oil exceeds the limit and analyzed and treated the high volume fraction of acetylene in the converter oil by the three ratio method, which has reference and guiding significance for the treatment of the same type of defects [6].

2. Event process

In ± 660kV DC project, each converter station has 12 converter transformers are in operation (6 for each pole). The converter transformer started operation in April 2021, and in May 2021, an insulation oil test was conducted. It was found that pole I converter transformers contained trace acetylene, with a maximum measurement value of 0.362ppm, a minimum of 0.198ppm, and an acetylene alarm value is 1ppm.

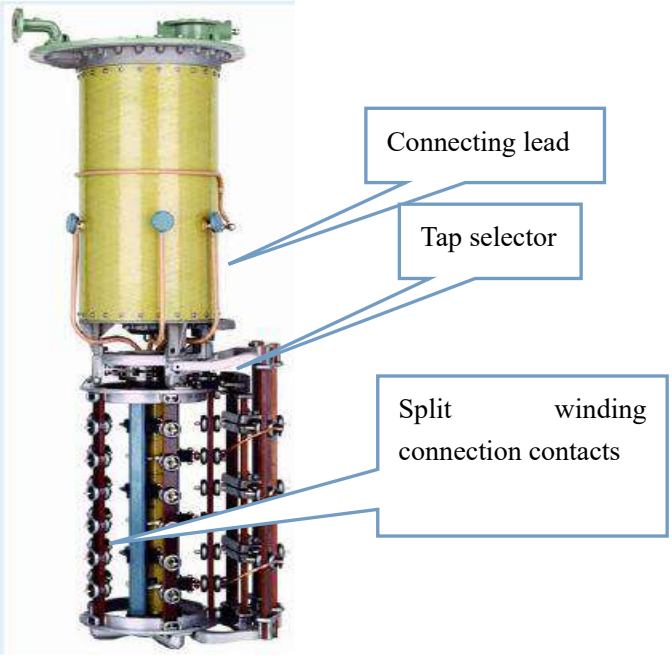
During the test in September, it was found that the acetylene of the converter station on the supply side rose to 1.31ppm, and the acetylene of the receiving was about 0.4ppm, which showed an upward trend.

3. Analysis of acetylene causes in converter transformer

3.1. Split switch function of converter transformer

DC transmission system has the characteristics of frequent DC power regulation and step-down operation, which requires the converter transformer on-load voltage regulation performance, its voltage regulation range is large, can achieve 80% to 100% voltage reduction operation requirements, its voltage regulation gear is more, set with 31 gears. Because of the converter transformer voltage gear, the voltage range is large to reduce the complexity of the voltage switch structure. Converter transformers are designed as positive and negative two-way voltage regulation; so that the converter transformer only needs, half of the voltage shift winding turns can meet the needs of the project. This is also the voltage regulation method often used in high-voltage direct

current transmission (HVDC).The principle of its pressure regulation is shown in Figure 1.



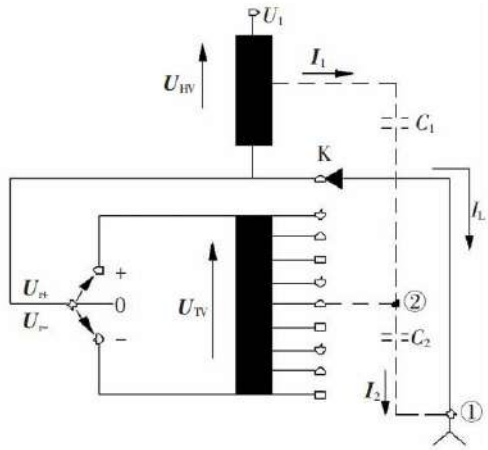


Figure 1: Split switch structure

A common load tap switch is mainly composed of a switching switch, potential switch, polar switch, transition resistance, potential resistance, electric operating mechanism, and related protective elements. The switching switch and transition resistance separate the oil chamber that is completely isolated from the oil of the transformer. It is mainly responsible for completing the ordinary tap switch gear adjustment, the switching process, the oil chamber can be filtered by the online oil filter; the potential switch, and potential resistance to limit the reference potential of the voltage regulating coil.

The polar switch is installed in the body oil tank of the converter transformer mainly responsible for the completion of the tap switch gear adjustment generally refers to the polarity switch of the 15th gear shift. The switching process also has the arc-pulling phenomenon. Acetylene and other gases generated by the action discharge will enter directly into the transformer body oil, causing acetylene in the insulating oil of the converter transformer.

3.2. Frequent action of the polar switch

The transmission system is unstable and the 500kV lines of many power plants frequently tripped, which affects the stability of the DC transmission power of the rectifier station to some extent. The automatic shift function of the converter transformer is frequently started, leading to the frequent action of the polarity switching of the converter transformer.

3.3. Analysis of frequent action of the polar switch

The DC system converter transformer contains 31 gear load tap switch, 1-31 gear, and polar switch changes at 16 gear. Switch between 15-16-17 step-up stages and 17-16-15 step-down stages respectively. Among them, the 16 rising and falling gears are divided into three steps: 16a, 16b, and 16c.

The principle of 16-gear shifting is shown in Figure 2. In the process of polarity switch switching, the main coil connects to the converter transformer network side sleeve, the load current flows in from the main coil, and then through the converter transformer neutral point casing outflow, where the arrow direction is the load current circulation direction.

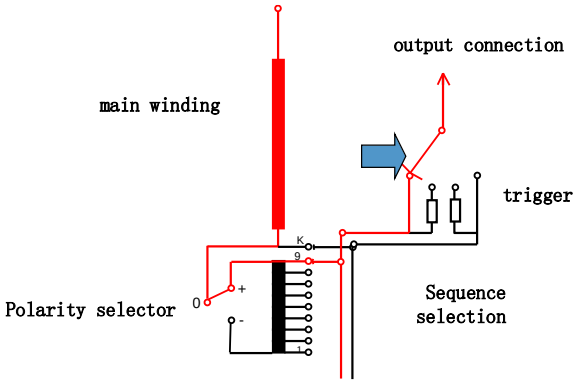


Figure 2: Principle of the 31-gear split switch（16a Level）

It can be seen from figure 2 when the tap switch gear of the converter transformer is 16a, the polar switch is in the position "K" and position "+" connection state, which is positive polarity when the load current flows through the main coil, polarity switch position "K", polarity switch position "+", voltage regulating coil and switch position "1".

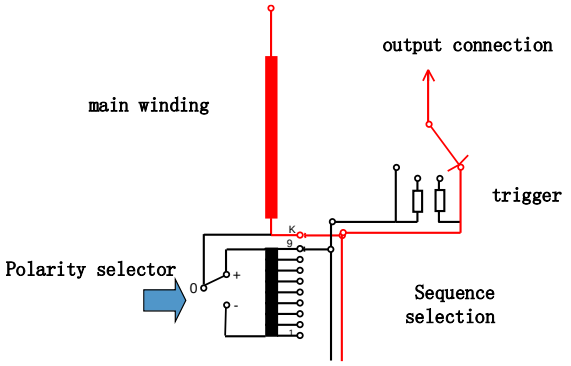


Figure 3: Switch to the 16b Level position

In Figure 3, when the next shift is 16b, the switch will change from position "1" to position "2" and then switch to 16b. The switch process will cause arc pulling in the independent oil room, and the load current flows through the main coil, polar switch position "K" and switch position "2".

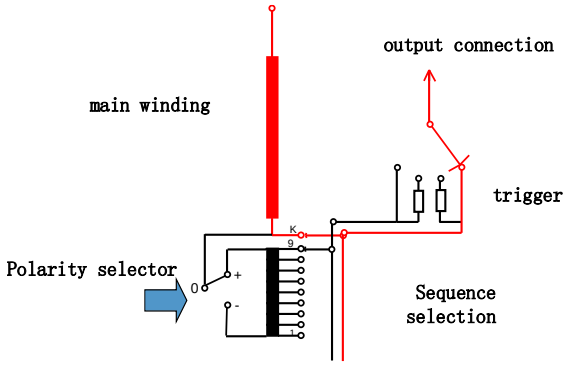


Figure 4: Switch to the 16c Level position

In Figure 4: When the converter transformer tap switch is ready to be adjusted from 16b gear to 16c gear, the Potential switch action is closed, put the regulating coil at ground potential, Polarity switch action. Switching from position '+' to position '-'. At this time, the tap switch gear is still 16 gear. The switching process causes the regulating coil to discharge the ground capacitor and the arc-pulling phenomenon occurs in the oil chamber of the transformer body. The load current still flows through the main coil, the polar switch position 'K', and the switching switch position '2'. The next step is to switch action, Transition from position '2' to position '1'. The polar switch is in the position 'K' and position '-' connected state, That is, the negative polarity, Transfer switch gear changes to 16c gear. The current flows through the main coil polarity switch position 'K', polarity switch position '-', voltage regulating coil, and toggle switch position '1'.

As can be seen from the switching process of the converter transformer compressor, the discharge phenomenon [4-5] exists in the switching process of the tap switch occur between 15-16-17 and 17-16-15.

In the process of the polar switch from position "+" to position "-", although the load current does not flow through the regulating coil the polar switch contact "+" or "-" flows between the main coil capacitor Ci and the regulating coil capacitor C2. The polar switch must cut

off the ground capacitor current to complete the normal switching, Resulting in spark discharge between the polar switch contacts, although the discharge energy is small, but still produce a small amount of acetylene gas in the transformer oil chamber. Similarly, the acetylene gas [6] will be produced in the oil room when the polar switch switches from the position "-" to the position" + ".

Therefore, the fundamental reason for the excessive acetylene content of the converter transformer compressor in the UHV converter station is the normal and frequent switching, which will cause the acetylene content of the transformer oil chromatography to exceed the allowable value, which brings great interference to the operation state analysis of the converter transformer compressor.

4. Field tracking and verification

The HVDC power transmission project was put into operation in early April 2021. In May, gas acetylene was found in the insulating oil of the converter transformer, with content between 0.198-0.362ppm. The converter station shortened the online oil chromatography sampling period, strengthened the monitoring of the oil data, and paid attention to the operation status of the converter transformer.

At the same time, the correlation curve of the acetylene content of the converter transformer showed alarm. The polarity of the tap changer of the converter transformer changes 125 times from 1st June 2021 to 1st September 2021. The acetylene in the oil rose to 1.31ppm, with a fast rise rate. The polar switch of the same converter transformer of the receiving converter station was operated 19 times from 1st June to 1st September and the acetylene in the oil rose to 0.36ppm, and the rising rate was slow. The actual verification results were consistent with the theoretical analysis.

5. Improvement measures

Due to the frequent action of acetylene in the insulating oil of the converter transformer, the following improvement measures were taken after analysis:

(1) Improve the power supply stability of the AC power plant, and reduce the switching frequency of the on-load tap switching polar switch of the converter transformer compressor.

(2) Strengthen the operation and maintenance of the oil chromatography online monitoring system of the converter transformer compressor, increase the frequency of the offline oil chromatography analysis of the transformer, and find out and eliminate the hidden dangers in time, to better control the operation state of the converter transformer compressor.

(3) Use the oil chromatography online monitoring system of the converter transformer compressor to regularly compare and analyze the acetylene gas content in the oil of the whole converter transformer compressor, grasp the changing trend of acetylene content, and carry out timely inspection and treatment once there is an obvious growth trend.

6. Conclusion

A converter transformer is different from an ordinary AC transformer. The converter transformer is equipped with an on-load voltage regulating device, in which a small amount of acetylene will be produced in the insulation oil during operation. The occurrence of acetylene is not necessarily a discharge in the converter transformer. Reducing the action of the polar converter switch can effectively reduce the content of acetylene in the insulation oil of the converter transformer and provide great reference significance for the analysis of the converter transformer.

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a. Operational Planning study for GCC countries, Kuwait, Saudi Arabia, Bahrain, Qatar, UAE and Oman under GCCIA (for 2021-22) including the following assignments: Steady state security assessment, Maximum power transfer (MPT), Dynamic security assessment, System protection analysis, Assessment of Spinning Reserve, System Base Lining for Inter Area Oscillations, and Small Signal Stability Analysis, Accelerated Fleet Change (Impact of Renewable Energy on the Interconnector), Voltage / Reactive Power Management Study.

b. Reactive Power Compensation including SVCs and FACTS devices in Saudi Arabia and Pakistan

- Series Compensation Study for 380 kV circuits between EOA (Dammam) and COA (Riyadh) in Saudi Arabia
- Three SVCs (-50/+600 MVAR) for Voltage Stability at Jeddah and Madina respectively in Saudi Arabia
- One SVC (-60/450 MVAR) for Voltage Stability at Kot Lakhpat at Lahore in Pakistan
- Reactive Power Compensation Study using Optimal Power Flow to identify the optimal capacitor placement in the distribution networks of LESCO and PESCO in Pakistan

c. System Studies for feasibility of HVDC intertie between Jeddah (WOA) and Riyadh (COA) in Saudi Arabia
d. HVDC transmission of big chunks of power at long distance i.e. for evacuation of power of nearly 40,000 MW from Thar and other locations in South to Mid-Country in Pakistan
e. Power System Expansion Planning ranging from 765 kV, 500 kV, 400 kV, 220 kV, 132 kV AC, and ±500 kV and ±600 kV HVDC for long, medium and short-term including load forecast, generation and transmission planning
f. Cross border interconnections involving HVDC and HVAC such as Iran-Pakistan, ECO countries, Nepal-India, and GCC countries.
g. Consultancy to World Bank on meeting the GoP targets of achieving 20 % by 2025 and 30 % by 2030 for Renewables (VRE) in Pakistan
h. Consultancy for Asian Development Bank on providing due diligence for Multi Tranche Funding for projects of NTDC and DISCOs of Pakistan
i. Consultancy for improvement/reinforcement of power system of Afghanistan, Nepal and Sri Lanka
j. Distribution Infrastructure Planning
k. Power System Analysis and Grid Interconnection of Conventional and Renewable power projects such as wind, solar, hydropower and bagasse-based generation plants
l. Feasibility studies of power evacuation from big clusters of hydro power plants and thermal power plants
m. Energy Policy, Regulatory Framework and Grid Code Development. A senior team member who developed recent Grid Code of Pakistan. Earlier he developed Grid Codes for Wind and Solar power grid integration in Pakistan and got approved by the regulator NEPRA as member Grid Code Review Panel
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Technical Papers and Conferences

a. SAARC Dissemination Workshop at Lahore, Pakistan in 2015 on "Technology Considerations for Cross Border Power Interconnections"
b. SAARC Training Workshop 'Power System Studies for Synchronization of Multiple Systems' at Kabul, Afghanistan 20-22 October, 2014
c. SAARC Dissemination Workshop on Study for Designing Management and Monitoring Framework for Regulatory Compliance by Power Transmission Utilities in the SAARC Region (Sri Lanka) in April 2015
d. Study of Energy Security of Afghanistan as consultant of GIZ
e. Consultant for 400 kV trunk line in Nepal as owner's engineer for US donor agency MCC
f. Training workshop for engineers of Ceylon Electricity Board, Sri Lanka on reactive power compensation and sizing and siting of an SVC at Colombo.
g. CIGRE, Annual Session held in Paris in August 2000; attended and presented paper titled Technical Feasibility of HVDC ILinks in Saudi Arabia, published in the CIGRE publication, Group 14, 2000 Session Papers
h. IIR, Institute for International Research, 6th Annual Middle East Power Generation Summit held in Dubai in November 2000: attended and presented a paper titled A Case Study of Interconnection Between Western and Central Regions of KSA
i. CIGRE Arab, Annual Session held in Ammann in 1997, Jordan: attended and presented paper titled The Significance of Small Signal Stability in Power Systems.
j. Institute of Electrical Engineers (IEE) Pakistan 1992: wrote paper titled as Transmission Link Between Tajikistan and Pakistan, HVAC or HVDC.

This picture is taken from "https://www.dreamstime.com/electrical-instrument-technician-checking-electricity-system-electrical-instrument-technician-checking-electricity-system-image122776779#_"

Electrical Signature Analysis. A remote, online and non-intrusive technique for analyzing motors, generators, transformers and other electric equipment.

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Abstract: Electric Signature Analysis (ESA) is a relatively new technology and is getting huge attention for its role in analyzing motors, generators, transformers, and other electric assets for the diagnosis of associated problems while they are in service. This technology can not only identify the issues within the electric equipment but also the problems being contributed to it by the power supply source or the load being driven. As a preventative maintenance tool, ESA can be employed to conduct testing to find, trend, and track the performance of any electric equipment. ESA is a remote and non-intrusive technique.

Keywords: Maintenance tool, preventive maintenance, non-intrusive testing, motors, generators, transformers

1. Introduction

For maximizing efficiency and profitability, organizations always try to improve efficiency by enhancing the reliability of their productive assets. So, predictive maintenance occupies a basic role to achieve a hh reliability for the functioning processes and the assets. Predictive maintenance can be defined as an important action to be performed on any equipment or installations, depending upon the prior information achieved through testing and recorded, concerned meters [1-2].

ESA is a non-invasive, online monitoring technique for the diagnosis of problems in electrical equipment. Though power quality tools are always available, the novel systems such as those based on ESA offer realistic, actionable information to fix the issues quite well in time in an effective manner and save the electric equipment from any serious damage. This is perceived to be the most effective tool for the assessment of motors, transformers, generators, and allied equipment in the processes. For example, vibration issues have particular impacts on the power signature of the motors, generators, or transformers and yet give no clue on the kind, and level

of the problem to most of us ESA is capable enough to highlight such vibration issues since ESA has translating capability which many of the existing systems don't equip. So, ESA is getting significant attention in industries worldwide and engineers are becoming more conscious to know and understand the working of the electrical signatures science. It is important to highlight that every kind of problem in any electrical equipment has its own specific power signature or impact on the normal power signature, which requires a good analysis from a number of cases so that to differentiate among different signatures. Many of the available fault diagnosing techniques are inferior in many ways and may not be able to pick the problem, but ESA is quite inclusive of a lot of information, which can't be skipped without revealing the important information on the abundance of issues, being carried with the processes, depending upon the electrical machines. Considering this context, this article is intended to disseminate vital concepts to guide new researchers about modern predictive maintenance through electrical signature analysis.

Generally, voltage and current information are captured directly from the Motor Control-Center (MCC) or Generator Control-Center (GCC), while the equipment is in service [3]. The collected information/data is then processed to find phase imbalance, motor loading, power factor, power harmonics, and the influence of the driven equipment on the motor or generator. Almost, all of the problems associated with the motor/generator's rotor bars or stator windings, air-gap issues such as rotor-stator eccentricity, gears, bearing issues, etc. are assessed. ESA is not only helpful in accessing electrical problems, but it also detects any mechanical fault, if present in the equipment. Depending on the captured signals' nature, the data can be processed using various techniques such as Current Signature Analysis (CSA), Voltage Signature Analysis (VSA), Extended Park's Vector Approach (EPVA), Instantaneous Power Signature Analysis (IPSA), among others. Variations in the voltage and current signals are analyzed in relation to some failure patterns, in both the time domain and the frequency domain, since the frequency domain gives a better insight into the signals present in the overall signatures captured.

1. ESA process

Figure 1 presents a pictorial form of the ESA process. ESA system can be divided in four main stages: (a) transduction of the interest signals; (b) acquisition of the data; (c) processing of the acquired data; and (d) diagnosis.

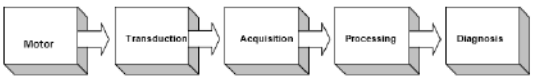

Figure 1: Steps of the Process of ESA

2. Scope of Dimensions of Research in this Area

The possible dimensions of research can be highlighted about the stages of the ESA process, in the figure These are listed below.

1. Improving data acquisition for voltage and current signatures by introducing more effective measurement and filtering circuits, depending upon the kind of electric signal, voltage, or current.
2. Signals processing to establish an effective correlative relationship between the captured current or voltage signatures from the time domain and the frequency domain, depending upon the kind of fault detected or fault-wise. Resultantly classification of the signatures would be required, not only dependent upon the kind of the faults but also depending upon the kind of electric equipment under test.
3. After the signals classifications, depending upon the kind of fault and the kind of electric equipment, there will be a need to automate the process of fault diagnosis which can be achieved by writing algorithms to incorporate the effective comparison of picked signals or signatures in the time as well as in the frequency domain so that to figure out the specific kind of the fault presence. This leads to tackling of the problem using AI sense in fault diagnosis based on ESA and remotely.

3. Conclusion

ESA is a very powerful tool with a single reading taken from a motor control center or disconnect being able to supply data from incoming power to driven load. Just this fact alone will often cost justify the addition of ESA to a

maintenance or reliability staff's arsenal. A lot of problems or faults which can't be seen or understood in the time domain signatures are often easily understandable in the frequency domain signatures. Some problems are found in the current signatures and some are found in the voltage signatures, so ESA gives a full insight of into the problems associated with any electrical equipment. This article was an attempt to give a generic overview of the research options in the domains of Electrical Signature Analysis for power system equipment maintenance. The new researchers and students may get an overview of this research domain and may get a good starting point to continue in this research area.

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اَفَلَا يَنۡظُرُوۡنَ اِلَى الۡاِبِلِ كَيۡفَ خُلِقَتۡ ﴿88:17﴾ وَاِلَى السَّمَآءِ كَيۡفَ رُفِعَتۡ ﴿88:18﴾
وَاِلَى الۡجِبَالِ كَيۡفَ نُصِبَتۡ ﴿88:19﴾ وَاِلَى الۡاَرۡضِ كَيۡفَ سُطِحَتۡ ﴿88:20﴾ فَذَكِّرۡ اِنَّمَآ
اَنۡتَ مُذَكِّرٌ ﴿88:21﴾ لَسۡتَ عَلَيۡهِمۡ بِمُصَيۡطِرٍ ﴿88:22﴾ اِلَّا مَنۡ تَوَلّٰى وَكَفَرَ ﴿88:23﴾ فَيُعَذِّبُهُ
اللّٰهُ الۡعَذَابَ الۡاَكۡبَرَ ﴿88:24﴾ اِنَّ اِلَيۡنَاۤ اِيَابَهُمۡ ﴿88:25﴾ ثُمَّ اِنَّ عَلَيۡنَا حِسَابَهُمۡ ﴿88:26﴾

(88:17) Do (these unbelievers) not observe the camels: how they were created? (88:18) And the sky: how it was raised high? (88:19) And the mountains: how they were fixed? (88:20) And the earth: how it was spread out?[7] (88:21) So render good counsel, for you are simply required to counsel, (88:22) and are not invested with the authority to compel them.[8] (88:23) But whoever will turn away (from the Truth), (88:24) Allah will chastise him with the most terrible chastisement. (88:25) Surely to Us is their return; (88:26) and then it is for Us to call them to account.

Introduction to a Book

Muslim Scholars and Scientists – Biography

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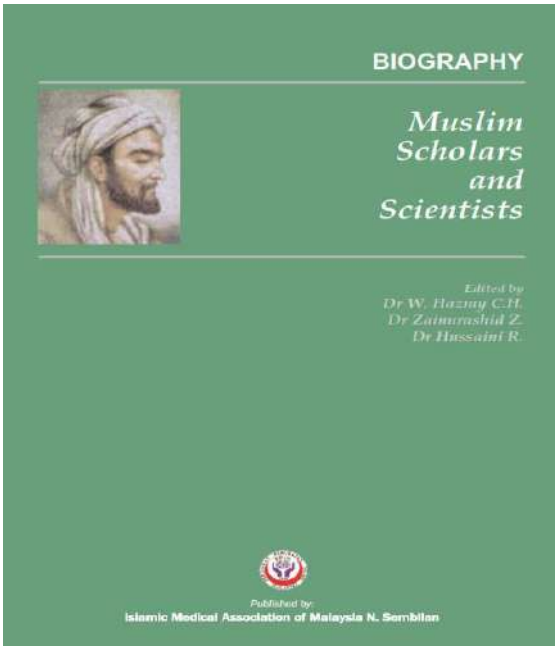

This article is being written to introduce to the readers of electron magazine, a brilliant book presenting the biographies of great Muslim scholars and scientists. The name of the book is "Muslim Scholars and Scientists-Biography". It has been edited by Dr. Wan Hazmy bin Che Hon (MBBS (Belgium), M.Sc. (Ortho) UKM), Dr. Zainurashid Zainuddin (MBBS (UK), MRCOG (UK)) and Dr. Mohamad Hussaini Razali (B. Med Sc, MD (UKM), M.Sc. IT), and has been published by Islamic Medical Association of Malaysia N. Sembilan.

Being a Muslim Pakistani researcher, I had always believed students at Pakistani Universities are always inclined towards getting an idea that the whole progress in the scientific world is by the courteous and rigorous efforts of non-Muslim scientists.

Therefore, modern-day Pakistani Muslim scientists do not find any Muslim legacy of scholarship to get inspired or motivated with, from a heroic perspective, and their minds simply get pressurized with the legacy of the greats of other nations. As a result, localized research gets hit and is affected badly and the best minds of the country move to other parts of the world to prove themselves while being contributors to scientific knowledge. No doubt, there is a huge number of non-Muslim scientists, who have done wonders in several avenues of research and knowledge, but it would be very unfair to not let the people of knowledge know about the immense and in several areas of knowledge, the foundation level contributions of the Muslim scholars.

To create a balance in the mindset of the current Pakistani generation, there is a need to introduce our students to the heroes of the universe of science, philosophy, and other domains of learning, belonging to their own creed also. After reading this book, I can now happily say that a brilliant effort has been made by the editor and authors of this book.

The Muslim scientist, thinkers, philosophers, and learners once ruled and led the world in the areas of knowledge. However, it sometimes becomes very difficult to first find and then study the detailed biographies of those legends. The book of discussion has been a brilliant effort to provide a short yet comprehensive introduction to the life history and works of Muslim scholars and scientists. The book has so beautifully narrated the scholarly legacy that it creates a feeling of pride to be the next spiritual generation of these scholars. It waters the seeds of knowledge inside the local scholar and gives new horizons and dimensions of thought process and hard work.

The book has also let the readers acquainted with knowledge of the context and struggles of the space and time to which the discussed scholars belonged. As an active researcher and part of the faculty of one of the best engineering institutes of Pakistan, i.e., University of Engineering and Technology, Lahore. I highly recommend and motivate the students to read this wonderful book.

This picture is taken from "https://www.pexels.com/photo/wind-turbines-and-solar-panels-during-daytime-9800092/"

Optimization of Microgrids using Metaheuristic algorithms

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Abstract: Due to global warming, environmental concerns are growing along with the electricity demand. The world is now shifting to clean energy (Renewables) to protect the environment. Distributed generation (DG), which has a cheap initial investment cost and is more favorable to renewable energy sources, has drawn a lot of attention in the power system over the past ten years. The main problem faced by the researchers is that during non-optimal conditions costs and losses increase drastically, and different methods are being applied to find the optimal solution for this problem as the core problem is still unsolved. To improve the performance of the microgrid, structural changes can be done or different evolutionary or meta-heuristic algorithms can be applied to optimize the control structure of the microgrids. This article discusses a fresh field of study for new researchers in the field of microgrids.

Keywords: Distributed Generation

1. Introduction

Researchers have sought to improve the control of microgrids using a range of models that are currently accessible. In [1] the author has presented the operation of different linear and non-linear microgrid models. Different quantities are optimized in grid-connected and autonomous mode i.e., damping resistance, and optimal design of LC filer while power-sharing coefficients and controller parameters are optimized in the latter. The nonlinear time domain and the eigenvalue-based objective function are proposed to reduce the measured power error and improve the damping characteristic. Through simulations of the nonlinear time-domain and eigenvalue analysis effectiveness and robustness of the proposed approach have been confirmed. The author has optimized the control of both grid-connected and autonomous modes using Particle swarm optimization which is a meta-heuristic algorithm.

In [2] the author has proposed a method to avoid the drawbacks of a Phase-locked loop (PLL) while tracking microgrid reference voltage for synchronization of active load and dynamic stability of autonomous microgrid is also investigated. The control design problem is best

resolved based on the time-domain simulation by minimizing a weighted objective function to control the inaccuracy in the measured active power and dc voltage. To verify the effectiveness of this method and the proposed controller different step-change disturbances are applied and a comparison is made between the existing and the proposed scheme to verify the superiority of the proposed approach. The author has concluded that the suggested synchronization mechanism has the potential to effectively increase microgrid stability. PLL drawbacks such as design complexity, subpar accuracy, nonlinearity, difficult tuning, slow response, and a detrimental effect on control performance can be avoided with the suggested approach.

In [3] the author has investigated the impact of active loads on the dynamic stability of microgrids. The accompanying controllers are intended for a concept of an autonomous microgrid with three distributed generations (DGs) using inverters and an active load. To ensure total system stability, controller gains for the inverters and active load controllers as well as Phase Locked Loop (PLL) characteristics are properly calibrated. Based on time-domain simulations, a weighted objective function is suggested to reduce the error in both observed active power and DC voltage. The key factors affecting the microgrid's dynamic performance are controller gains and power-sharing settings. Droop control is utilized to divide the power between DG and SG by simulating the synchronous generator, droop control is employed to distribute the power between DGs.

2. Metaheuristic algorithms in control of Microgrid

As discussed earlier, there are many methods to optimize the microgrids but as they are non-convex and non-linear in nature it is not easy to apply deterministic algorithms such as Newton Raphson and Gauss-Seidel method as they can stuck in local minima or maxima during optimization.

The irregular and stochastic nature of the energy management issues is considerably worsened by the growth of renewable energy generation. There is a need to optimize microgrids so that the energy management system can operate effectively. The ability to control a microgrid more effectively than currently optimized microgrids is made possible by metaheuristic algorithms. A stochastic component offered by metaheuristic algorithms aids in the search for the optimal microgrid control solution. Metaheuristic algorithms such as Particle Swarm Optimization (PSO) can be used to control the optimization of microgrids. The effects of different distribution functions on the PSO algorithm using different random values produced by these distributions give different results. If we employ normal PSO and linear decreasing inertia weight (LDIW) PSO algorithms to create random values generated by uniform distributions in the ranges of [0, 1] and [1, 1] and Gauss distributions with mean 0 and variance 1 U[0, 1], U[1, 1], and G (0, 1). For comparison, this study looks at the deterministic PSO approach, in which the random values are fixed at 0.5. Some benchmark functions and pressure vessel design issues are designed to assess these methods with various types of random values in three space dimensions (10, 30, and 100). According to the experimental results, standard PSO and LDIW-PSO algorithms using random values are more likely to avoid local optima and quickly discover global optima. This is due to the possibility that large-scale random values will expand the particle's velocity range, increasing the likelihood that it will escape from the local optima and locate the global optima[4]. Similarly, if particles are generated using PSO or any other metaheuristic algorithm we can find the optimum or minimum depending on the requirement we can optimize the microgrid by maintaining the desired power of the microgrid.

3. Scope of Dimensions of Research in this Area

The potential research dimensions can be emphasized as follows:

1. To design different models of microgrids to improve the active power and voltage of microgrids by improving synchronization between load and supply using a Phase Lock Loop (PLL) or propose any other method that can replace PLL.
2. To apply different existing metaheuristic algorithms to different models of microgrids to provide the optimal value of active power that

minimizes the error in output voltage and the microgrid delivers maximum power.

3. To design new variants of metaheuristic algorithms on microgrids and compare the results of different algorithms and find the best possible results.

4. Conclusion

Metaheuristic algorithms are very effective algorithms to find the optimal solution to different optimization problems due to the stochastic element present in them. They are very effective in optimizing the cost and losses of microgrids during non-optimal conditions by providing the exact value of power so that the voltage error is minimized. A general summary of the research possibilities in the areas of metaheuristics for microgrid optimization was attempted in this article. The overview of this research field may be helpful to new researchers and students may find this to be a useful starting place for further study in the field.

5. Reference

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