Computer-Aided Training Module for Power System Analysis and Design

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Abstract— Electrical Transient Analyzer Program (ETAP) is an enterprise solution software widely used for the simulation, design, and analysis of power system networks. ETAP is the power engineers’ tool in designing and evaluating power system performance under normal and abnormal condition. The engineer had to be equipped with a good understanding of how the software can be used. Available training on the use of ETAP is quite expensive such that a typical student or an electrical engineer cannot normally afford to pay. This paper presents the details of tutorial workbook intended to help students and power engineers learn ETAP in an easiest possible way. A tutorial workbook on network building, power flow analysis, and fault analysis was developed and tested among a select number of electrical engineering students. On average, 90% of the students find it easier using ETAP with the aid of the tutorial workbook.

Keywords— tutorial workbook, ETAP, power system analysis

1. Introduction

Power System Analysis and Design is one of the most important modules taken by a student who want to pursue degree in electrical engineering. Computer software’s are developed to aid users to perform complex calculation and task accurately and efficiently. Perform complex calculation manually can be time consuming and inaccurate due to human error. Network modeling tool is computer software developed to aid users of power system to simulate their design prior to implementation. This can be also used to aid student in learning power system [1].

Electrical Transient Analyzer Program (ETAP) is network modeling tool where users can model, simulate and run various analyses on power system. ETAP is a well-known tool widely used in industries and educational institutes around the world. Whereby, top 10 electrical design companies in the world use ETAP. In Malaysia, utility grid owner Tenaga Nasional Berhad (TNB) uses ETAP to design and simulate their electrical power system prior implementation [2]. Hence, this shows the importance for an Electrical Engineer who plans to explore the power system field to learn ETAP. Besides that, students can use the aid of ETAP to learn power systems efficiently applying their theoretical knowledge to work.

Currently there are is two form of learning material available in the market for self-learning basis. One of the materials available is a demo guide book which is a manual [3] presented with the software on some key features on the software. Whereas the other option is, a limited number of video tutorial [4] on key analysis and setup which is a media guide for user to use the software.

In the case on more guidance required, proper training and workshop can be arranged with consultancy firms of the software and the ETAP organization itself. This type of guidance requires cost in exchange of service. Thus, this is a very expensive option usually approached by industries and not individual as many could not afford. Thus, the objective of this research is to develop Computer-Aided Training Module for Power System Analysis and Design. Whereby, a tutorial workbook was developed to aid users in conducting power system analysis and design using network modeling software ETAP. The tutorial workbook produced encompasses network construction, load flow and fault analysis. The impact of the tutorial workbook was evaluated in the form of survey conducted on a group of individuals who are learning power systems. Their evaluation on the tutorial workbook are important are used for future development of the workbook.

2. Methodology

The research methodology approached in this research is shown in Figure 1. The ETAP demo guide book [3] was reviewed and critically analyzed in terms of features and translation of procedures to actions. It can be said that the present guide book are well presented in terms of coloring and proper diagrams are provided for guidance. Some draw backs are found whereby, proper examples on conducting various analyses and constructing networks are not provided.

Based on the result of analyses performed on the guide book, training materials on network building, load flow and fault analysis was obtained from power system lecturer lab sheets to be used as example in the tutorial workbook. Simultaneously, training material on network building load flow and fault analysis is analyzed and picked to be used in the tutorial workbook as a worked example.

Based on the guide book as reference, the training material obtained was simulated on ETAP as self-training. Whereby, the procedure performed in conducting the simulation will be presented in the tutorial work book in terms of diagrams and explanations. These procedure involved and interpreted was the input for the tutorial work book.

The tutorial workbook made was checked and ensured it encompasses all the fore mentioned features such as network construction, load flow and fault analysis prior to completion.

The tutorial workbook developed was tested on a group ten Electrical and Electronic Engineering students who are currently taking studying the power system module. The students are tested with different tutorial question from the sample practices provided in the tutorial workbook. Upon, completions of the test students are provided with a survey form to retrieve their opinion on the impact of the tutorial workbook.

![Figure 1: Block diagram of the research methodology](image-url)
The survey result was analyzed in terms of bar charts in order to know the impact of the tutorial workbook on network building, load flow and fault analysis prior to using the tutorial workbook and after using the tutorial workbook. Comments and recommendations from students are taken for future improvisation of the tutorial workbook.

Based on Figure 3, it is shown that students find it easier to build their network on ETAP with the aid of the tutorial workbook. This is because the tutorial workbook shows step by step procedure on how to set specifications, where to input the specified values and where the equipment’s icons are located. On average, 90% of the students improve their skills on network building on ETAP.

Figure 4 shows 90% of the students are capable to perform load flow analysis on ETAP with the help of the tutorial workbook. The balance 10% of the students gave negative feedback on the tutorial workbook. This may be due to lack of basic understanding of the student on load flow.

3. Results

With reference to Figure 2, it can be seen that mostly students have difficulties on using ETAP for the first time because they have no proper training or guidance on using the software. Thus, this proves that the guide book provided by ETAP insufficient and unproductive as many student faced difficulties in performing the highlighted tasks. It can be said that 80% of the students faced problems on building a network on ETAP because they have issues in setting the specifications which was provided.

Based on Figure 5, it can be noted that 90% of the students can perform fault analysis with the help of the tutorial workbook. Aside the help of the tutorial workbook, it is important for students to learn the topic prior simulating their learning on software’s.

4. Conclusion

Based on the results obtained, the tutorial workbook developed is capable in assisting the students or users to use ETAP. On average, 90% of the students find the tutorial workbook productive and beneficial in assisting them to use ETAP. The remaining 10% of students find that there are rooms for improvement for the tutorial workbook. In conclusion, the tutorial workbook meets it purpose which is to help students to build networks, run load flow and fault analysis on ETAP.

References