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Increasing Interest of Power Engineering Students with Powerworld@ Simulator and Soft Computing Techniques

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Abstract

Graduation level students are dealing with old available motors and wiring systems in laboratories. This results into low interest of students and narrow focus of usual power engineering. Our students have there on requirement and it is clear that the focus of power engineering education needs to be increase considerably to contain these needs. So the need of improvement of educational lessons is demand of today. The indicated control on the needs of industry suggest that the syllabus in the undergraduate and graduate programs should be thoroughly restructured and brought into line with power engineering needs. Using soft computing will make the courses attractive to the students through the use of computer ready classrooms, interactive problem solving and multimedia presentation. These methods will improve teaching efficiency and increase student interest.

Key Words: power engineering, simulator, education, soft computing

Introduction

Various attempt we are applying all over the world to make the clear understanding of power systems to our power-engineering students. Applicability of artificial intelligence is also shown in various papers for power engineering students [1]. Everyone on this earth is related to electric power supply utilization directly always or indirectly in other way of power energy. After reaching to fields they find everything changed rapidly. One of the most challenging aspects of engineering education is to give students an intuitive feel for the systems they are studying. Such a background has been, and continues to be, crucial. But while paper and pencil exercises can be quite useful for highlighting these fundamentals, they often fall short in imparting the desired intuitive system insight.

To better replicate actual system operation, in which power system operators and engineers work to insure that there are no violations in either the base case or for a set of statistically likely contingencies, the design project required the students to perform a full contingency analysis solution. If done manually this would have required the students to sequentially open each of the individual lines and transformers, solve the power flow, check for violations, and then close the device. While performing such a procedure manually once or twice might have some educational benefit, it would rapidly become tedious during a design process. Rather, the students were encouraged to use the built-in contingency analysis functionality. With a click of a button the full contingency analysis set was run (in about a second), with the results displayed based upon the severity of the violations. Of course, in real life a design engineer would be presented with a wide variety of different design possibilities, such as upgrading existing lines, constructing new lines, constructing new generation, adding power system control devices such as switched capacitors or FACTs, implementing interruptible load control, or moving substation load through changes in the distribution system.

However, simultaneously many of these possibilities would be eliminated through considerations such as cost, right-of-way restrictions, public opposition to new construction, and environmental constraints. While the software environment allowed students to easily add new lines and transformers, nevertheless, students who blindly attempted all possibilities had to do a good amount of analysis. Hence, one of the project goals was to have the students realize that an understanding of the "why" behind the system violations could help to guide them in limiting the number of design possibilities they needed to consider. Key to providing the students with intuitive insight into the operation of a power system is the use of a user-friendly, highly interactive graphical user interface [4].

THE ROLES OF SOFT COMPUTING:

Based In the last few years various blackouts all over the world creating doubts in power engineering students. Specially recent blackout of Washington, USA and blackout of England during year 2004 causing students to think for some new dimensional studies. As they expect that conventional methods be used at top level in America and England even then where they are lacking in power control techniques. So the need of Artificial Intelligence is a demand of power engineering students. Soft computing differs from conventional (hard) computing in that, unlike hard computing, it is tolerant of imprecision, uncertainty, partial truth, and approximation [2]. In effect, the role model for soft computing is the human mind. Soft Computing (SC) is a group of methodologies, which provide a foundation for the conception, design, and deployment of intelligent systems. The principal members of SC are fuzzy logic (FL), neuro-computing (NC), genetic computing (GC) and probabilistic computing (PC), with PC subsuming evidential reasoning, management of uncertainty and parts of machine learning theory.

Within SC, the main contribution of FL is a methodology for dealing with imprecision, approximate reasoning, fuzzy information granulation and computing with words; that of NC is system identification, learning and adaptation; that of GC is systematized random research, tuning and optimization: and that of PC is decision analysis and management of uncertainty [3]. The essence of soft computing is that unlike the traditional, hard computing, soft computing is aimed at an accommodation with the regular imprecision of the real world, Thus, the guiding principle of soft computing is: Exploit the tolerance for imprecision, uncertainty and partial truth to achieve tractability, robustness, low solution cost and better relationship with reality. In the main, FL, NC, GC and PC are complementary rather than competitive. For this reason, it is frequently advantageous to use FL, NC, GC and PC in combination rather than exclusively, leading to so-called "hybrid intelligent systems." At this juncture, the most visible systems of this type are neuro-fuzzy systems [5,6].

NEED OF POWERWORLD SIMULATOR:

Motivated As power systems become increasingly complex, there is a critical need to make available improved tools for training power system engineers and analysts. Q-V curve interpretations of energy measures for voltage security also discussed already using PowerWorld simulator [7] Traditionally this training has been provided primarily to student engineers, system operators, and practicing engineers. However, a worldwide trend towards increasingly more open transmission systems, the growing competition in electricity markets, the changing role of regulation, and the entry of new working professionals into the electricity business has created an unprecedented need to provide personnel without an extensive technical background with at least a basic understanding of power system operations. In particular, these people need an understanding of the effects of various power and energy transactions on system operation, and the constraints often imposed by the transmission system.

The motivation for the development of the program described in paper was to have a self-contained power system simulation program for instruction both of engineering undergraduates' personnel with a non-technical background invo1ved in the electricity business. This required the use of a user-friendly GUI so the students could spend their time gaining an intuitive feel for operating an electrical system, rather than just learning how to use the program. Basic concepts needed to be presented simply, yet the program required sufficient detail to maintain the interest of and provide challenge to the advanced engineering student. The principal thrusts of the program include basic power flow in a network, how system controls (such as generator MW/voltage set point, LTC transformers, line outages, and power transactions) affect power flow, and area control concepts such as area control error (ACE), automatic generation control (AGC) and economic dispatch (ED).

SYSTEM ONE-LINE DIAGRAM:

The student operates the system primarily by using a dynamic one-line diagram to change system controls including generator MW outputs, LTC transformer tap positions or circuit breaker status. As an example, Figure 1 shows the one-line diagram for a seven-bus system. This system is having 7 buses, 5 generators, 6 loads and 11 transmission lines (AC). Total load 760.0 MW and 130.0 Mvar. Total generation is 768 MW and 103 Mvar. Losses at flat start are 8 MW and –26.7 Mvar. Generator spinning reserves are 1432 MW and –318 MW. Bus number 7 is slack bus. Windows allow the student to interchange power from other (external) areas, to further monitor the system, and to change various options. The student is responsible for operating the system at minimum cost while maintaining correct area interchange, and ensuring that system voltages and flows are within their limits. Different data cases can be used to simulate different systems. A student can start operating just a two-bus system and then work up to increasingly larger systems.

The one-line diagram and simulation time windows are then displayed along with a menu bar. At any time during the simulation, the student can interact with the case (such as by changing controls or setting up MW transactions) through the various windows. The one-line diagram is the most important part of the graphical user interface (GUI). The one-line representation, like all of the other windows in the program, has been designed using object-oriented techniques. The advantages of this approach include flexibility to allow the user to interact with all objects on the screen, small source and executable files, extensibility and reusability of existing code, and a user-friendly graphical user interface (GUI). The one-line uses graphical symbols to represent system equipment such as buses, generators, loads, transmission lines and transformers.

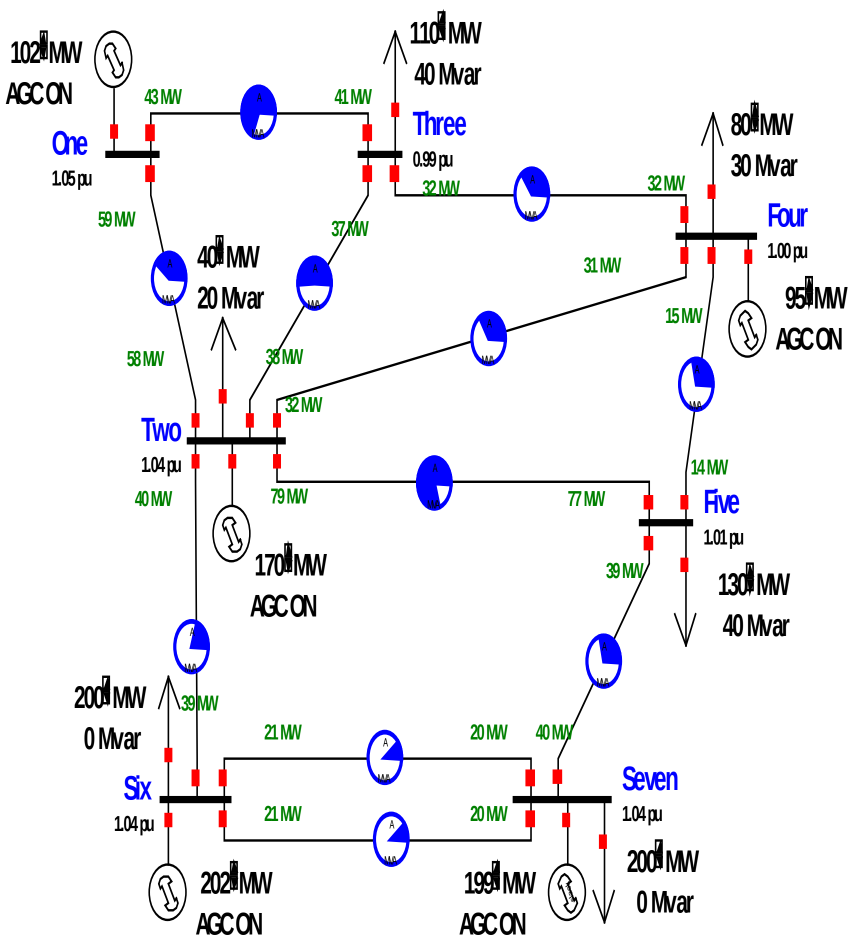

Figure 1. Standard seven bus flat system.

A combination of numeric values and graphical symbols are used to show system values. Numeric values are used to show bus voltage magnitudes, and load generation real and reactive power values. However, graphical pie charts are used to show percentage line loading. As the line loading increases, the pie becomes increasingly full; for flows above the transmission line's limit the pie changes color from blue to red, with the percentage value then shown in the interior of the pie. Additionally, the rotor position changes to indicate the voltage angle at generators. Options are provided to show the voltage magnitudes in either per unit or actual kV.

The user can control the simulation by clicking the mouse on different components on the one-line. For example positioning the cursor on the circuit breaker symbol and clicking the right mouse button, while clicking with the left button closes them can open circuit breakers. Because of the fast display update rate, the new flows appear almost instantaneously. Transformer taps, generator set point voltages, and capacitance values can also be modified in a similar manner. By double clicking with the left button on the actual device symbol the user can view and sometimes modify different parameters associated with the device. If desired, the user can also use the double border of the one-line window to change its size or position on the screen.

SYSTEM DATA FILES:

Each power system case has two associated data files. The first file contains the one-line diagram information. The one-line displays are currently built off-line using a separate Windows-based program. The time required to build the one-line diagram depends upon the system size and complexity. The second file is a text file that contains all the remaining information necessary to define the case. The actual power system information is defined in the beginning of this file using the IEEE common data format. The remainder of the file then contains various simulation options and more detailed device modeling information. For example, to simulate the daily load variation, the real and reactive load at each bus is modeled as a piecewise linear function of time. Additionally, specific events such as removing/inserting lines can be Object Hierarchy scheduled in this file to occur at specific times during the simulation.

For each time steps in the simulation a number of adjustments are automatically made to the system. All transmission lines are assumed to have thermal loading huts, with the line being capable of indefinite operation for any loading at or below this value. However, for loadings above this limit, the line temperature starts to increase. Load and generation at the removed buses are set to zero. For each time steps in the simulation a number of adjustments are automatically made to the system. First, the real and reactive loads at each bus are changed according to their piecewise linear model. Second, any scheduled events are enacted; third, the system is checked for limit violations. If this were to occur in actual operation, the system would probably experience a voltage collapse induced blackout. In the simulation anytime the power flow fails to converge, it is assumed that such a situation occurs. A message is displayed on the screen indicating that a blackout has occurred, the windows dim to a dark gray, and the simulation pauses.

CONCLUSION:

Soft computing application can be used by the instructor as a lecture tool to demonstrate phenomena such as load cycling during a time period, power flows on parallel lines, correlation between reactive power and voltage, economic dispatch, area control error, automatic generation control, wheeling, and the impact of contingencies on system operations. The instructor could simulate line outages during the simulation to show the impact of lines out for maintenance or lost due to contingencies. Intervention by the lecturer is sometimes required to provide manual generation rescheduling to remove any resultant overloads. This combination of soft computing and PowerWorld simulator will increase the interest of students during studies and after joining power engineer job they can apply latest available tools and software to face the challenges of biggest system on earth that is power system.

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