7 Conclusions and Future Trends in Emerging Techniques

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A number of emerging techniques for power system analysis have been described in the previous chapters of this book. However, given the complexity and ever increasing uncertainties of the power industry, there are always new challenges and consequently new techniques that are needed as well. The major initiatives in the power industry of this decade are no doubt renewable energy and more recently, the smart grid. These new challenges have already encouraged engineers and researchers to explore more emerging techniques. Given the fast changing environment, some of the techniques may become more and more established for power system analysis. These rapid changes also result into the wide diversity in the emerging techniques; consequently, this book can only cover some of these techniques. However, it is expected that these techniques discussed in the book can provide a general overview of the recent advances in power system analysis. As the technology advances, continuous study in this area is expected. This chapter summarizes some of the key techniques discussed in the book. The trends of emerging techniques are also given, followed by a list of topics for further reading.

7.1 Identified Emerging Techniques

The following key emerging techniques have been covered in this book:
- data mining techniques and their applications in power system analysis;
- grid computing techniques and their applications in power system analysis;
- probabilistic methods for power system stability assessment and planning;
- phasor measurement units and their applications in power system analysis.
Other emerging techniques, which are also important but only briefly introduced in this book, are:

- power system load modeling;
- topological methods for system stability and vulnerability analysis;
- power system cascading failure;
- power system vulnerability analysis;
- power system control and protection.

Detailed descriptions of the above listed techniques have been given throughout Chapters 1–6. They, together with the conventional methods, provide the power industry much needed tools for system operation, control, and planning tasks. Many of the emerging characteristics of the power system nowadays had been considered in these techniques; however, not all of the needs from the power industry have been addressed satisfactorily. The emerging techniques themselves are evolving as well to meet the rapid development of the power industry today. It is necessary to recognize the trends in the power industry development which help to define the new challenges and opportunities, as well as the scope of corresponding new emerging techniques.

### 7.2 Trends in Emerging Techniques

In the past few years, the power industry worldwide has been experiencing more rapid changes which lead to new opportunities as well as challenges. Among the external factors leading to the changes are government policies. The growing awareness and practice in renewable energy and sustainable development have introduced a significant amount of renewable energy into the electricity supply sector. Along with the technical challenges associated with the renewable generators such as wind power generators and solar power generation units, emissions trading and carbon reduction policies also contribute significantly to reshaping the power industry. From 2009, the move towards a smart grid which combines the physical power system with information communications technology (ICT) has attracted huge investments in several major countries including the USA and China. Although the definition and scope of a smart grid is largely vague and varies with the individual government, the overall trend towards a more intelligent power system is clear. Techniques such as self-healing systems, power quality improvement techniques and ultra-high voltage DC and AC transmission system, and associated ICT techniques will be among the key techniques to facilitate the smart grid move.