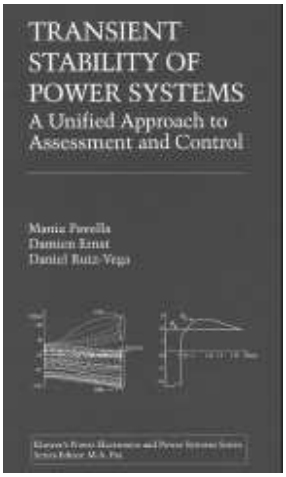
Transient Stability of Power Systems - A Unified Approach to Assessment and Control



by Mania Pavella, Damien Ernst and Daniel Ruiz-Vega

Kluwer's Power Electronics and Power Systems Series
ISBN 0-7923-7963-2
Published in 2000, 237 pages
by Kluwer Academic Publishers

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This book comes at an opportune moment since new dynamic security assessment functions are now being incorporated into energy control centers in many utilities. This monograph describes a direct method based on a generalised **One Machine Infinite Bus** (OMIB) equivalent.

The book has 7 chapters, 2 appendices and the subject matter is covered in a compact 237 pages. This is an excellent book on the topic, and is destined to join the rank of classics. The book is professionally written by the authors who are led by a a recognized authority on the subject. In addition, the book is professionally type-set (by Mrs. Lecomte, I imagine) and the english usage is excellent. For a reviewer these facts made the task of reading and comprehending a difficult subject that much easier. Each chapter commences with a brief 'Objectives of the Chapter' and finishes with a Summary of the chapter.

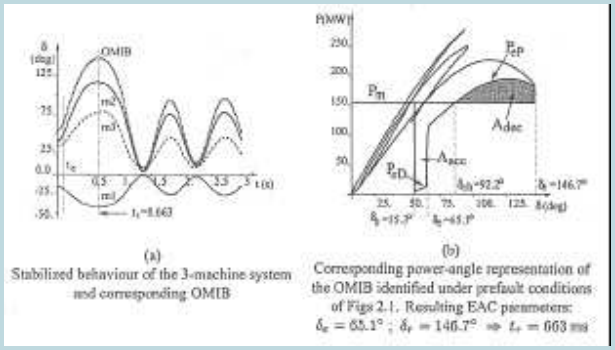

Figure 1: Swing curves and OMIB P-δ representation of the 3-machine system. Contingency Nr 2; t_e = 92 ms.

The authors explain early on for the need of another book on Transient Stability: "The nonlinear character of transient stability, its fast evolution and its disastrous practical implications make it one of the most important and at the same time most problematic issues to assess and even more to control, especially today, with the emerging deregulation practises of the electric sector in many countries". The present monograph is devoted to a comprehensive and unified approach to Transient Stability Assessment and Control (TSA&C) called **SIngle Machine Equivalent** (SIME) method which is based on the Ph.D. thesis of Dr. Y. Zhang, a former student of Mania Pavella.

Chapter 1 provides the historical background to the main topic of Transient Stability (TS) and the two methods - direct and automatic learning - for solving the problem of TS. The automatic learning methods are only briefly described as they do not form the focus of the monograph. The direct methods are described in more detail to provide an understanding for the SIME method which is referred to as a hybrid direct method. The foundations of the OMIB equivalent are laid out in the observation that in a multi-machine system, the loss of synchronism originates from the separation of its machines into two groups; these groups are first replaced by single machines and then eventually by an OMIB equivalent.

An introduction to the SIME method is provided in Chapter 2. The OMIB is viewed as a transformation of the multidimensional multi-machine dynamic equations into a single dynamic equation and is based on the classical equal-area criterion (EAC). Appendix A provides information on the equal area criterion (EAC) for assessing TS in a simple and comprehensive way. Illustrations are provided by using the Hydro-Quebec system as an example.

Chapter 3 provides the core of the SIME methodology. The use SIME calculated margins provides suitable performance indicators for sensitivity analysis to be carried out.

Chapter 4 derives a systematic procedure for computing stability limits and describes a variety of techniques for screening cases and selecting the constraining cases. Procedures are developed for stabilizing the constraining cases, and paves the way towards the use of on-line TSA techniques.

In Chapter 5, the on-line techniques elaborated in Chapter 4 are organized in a software package. This software package can be either used alone or interfaced with an OPF program to broaden its possibilities. Ways of integrating this package within an EMS environment to perform on-line congestion management calculations are also explored.

Chapter 6 deals with the next generation on-line TSA techniques for providing emergency control to prevent instability and separation of the system.

The book contains two Appendices. Appendix A provides a refresher on the classical Equal Area Criterion for assessing TS.

Appendix B provides data of the simulated systems used in the book such as the 3 machine test system model adapted from the EPRI system. Other systems used are the Hydro Quebec and Brazilian test systems.

This is a book that will become a classic in its own right with time. For those who work in the domain of TSA, it is a must-read monogram. The book is professionally edited. I would have preferred to have the references at the end of each chapter rather than at the end of the book; but that is a personal choice. The graphics and figures are carefully drawn and well presented; the one figure that I had some exception to is Figure 1.6 on page 25 which has been taken from an earlier reference. The use of practical examples with the Hydro-Quebec and Brazilian systems are also appropriate for the subject. The book will be useful for graduate researchers and practicing engineers alike.

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The CR Editor acknowledges the support of Mr. Alex Greene (email: Alex.Greene@wkap.com), Kluwer Academic Publishers for his support of this Book Review.