Optimal Power Flow Technology for Power Systems: Theory, Computation, and Practical Applications

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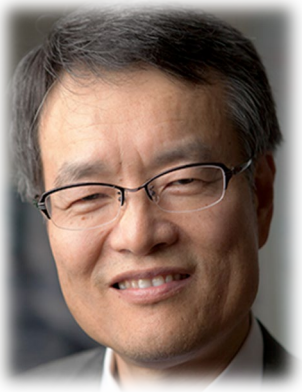
OVERVIEW

The goal of an optimal power flow (OPF) is to determine the "best" way to operate a power system. Usually "best" = minimizing operating cost or system power loss, while operational and engineering constraints are satisfied. According to a FERC of USA study, a good AC OPF solution engine can save tens of billions of dollars in the US alone every year. SuperOPF is a practical and powerful AC OPF solver, developed by Bigwood Systems Inc. under the sponsorship of Department of Energy, USA and several utility companies in the last 15 years. SuperOPF has been extensively evaluated on practical OPF models ranging from 15,000-bus models to Co-optimization problems with 250,000 control variables. Even though the theoretical foundation of SuperOPF is solid, it may occasionally fail to compute a AC OPF solution due to issues such as the non-existence of an OPF solution and bad initial starting points. To deal with these issues, we have developed theoretical foundation for feasible regions of AC OPF problems. In this talk, a complete characterization of the feasible region of OPF problems will be presented. This complete stability property enables the development of solution methods for identifying the existence/non-existence of feasible solutions. In addition, practical applications of SuperOPF to large-scale power systems such as the Tokyo Electric Power Company, Tokyo, Japan, PJM Interconnection, PA, USA, and EGAT, Thailand will be illustrated.



BIO

Dr. Hsiao-Dong Chiang (F'97) received the Ph.D. degree in electrical engineering and computer sciences from the University of California at Berkeley, Berkeley, CA, USA. Since 1998, he has been a Professor in the School of Electrical and Computer Engineering at Cornell University, Ithaca, NY, USA. He and his team members have published more than 458 referred papers with the H factor of 66 and more than 18,000 citations. He holds 30 U.S. and overseas patents and several consultant positions. He is the author of two books and was elected IEEE Fellow in 1997. He has served as an associate editor for three different IEEE transactions and journals, and served as a board member for IEEJ Japan. He is the founder of Bigwood Systems, Inc. (established in 1995), and of Global Optimal Technology, Inc. (established in 2000), both located in Ithaca, NY, USA. In Japan, the BCU method, invented by Dr. Chiang, was documented and displayed in the Electric Museum of TEPCO Research Center facility located in Kawasaki, Tokyo, Japan. In 2022, he and his team members received Best paper recognition from IEEE Trans. On Power Systems and Best conference paper from IEEE PES. In 2023, his team ranked top 1, top 1 and top 2 (division #1, #2, and #3) in US ARPA-e Grand Competition III (on large-scale Unit Commitment problems).