

## **TUTORIAL: Optimization techniques and the mathematical tools for decision-making in energy systems.**

Optimization is a very important tool that can be used to solve several decision-making problems. The wide and growing use of optimization makes it essential for students and practitioners in every branch of science and technology. Particularly, in the area of electric power systems, there are many planning and operating problems that can be modeled as an optimization problem and then solved using commercial tools. In the first part of this tutorial, we will present a review of the basic concepts of mathematical modeling, the classical mathematical programming problems (such as, linear programming, integer programming, and nonlinear programming) and the main classical optimization techniques (such as, simplex method, interior point method, and branch and bound algorithm). As well as, we will show the use of the algebraic modeling languages and the existing commercial solvers, and its advantages in the modeling and solving of optimization problems. At the end of the first part, some optimization illustrative examples will be modeled and solved. In the second part, three well-known optimization problems in the area of electric power systems (economic dispatch, transmission network expansion planning, and reconfiguration of electric distribution systems) will be modeled and solved using the algebraic modeling language AMPL, and the commercial solver CPLEX. For each problem, different test systems will be used and analyzed. At the end of the second part, we will discuss the difficulties of solving optimization problems in large-scale systems, as well as the future of optimization techniques.

### **LECTURER: Marcos J. Rider**

He received B.Sc. (Hons.) and P.E. degrees from the National University of Engineering, Lima, Perú, in 1999 and 2000, respectively, and an M.Sc. degree from the Federal University of Maranhão, Maranhão, Brazil in 2002; he earned a Ph.D. degree from the University of Campinas (UNICAMP), Campinas, Brazil in 2006 - all in electrical engineering. He worked as a Researcher Associate and Visiting Professor at UNICAMP (2006-2007; 2008-2010) and Universitat Politècnica de Catalunya, Barcelona, Spain (2007-2008). He was a Professor at Paulista State University in the Campus of Ilha Solteira (2010-2015). Currently, he is an Assistant Professor in the Department of Systems and Energy at UNICAMP, researcher 1D of CNPq and IEEE Senior member.



Participated as principal investigator or collaborator in more than 20 R&D projects for Brazilian utilities and government agencies. He has published 2 books, chapters, over 120 full papers in scientific events, and over 70 journal papers in scientific journals, most of which have been published in international journals indexed by ISI, which are classified as Qualis A1 by CAPES. The ISI Web of Science database lists more than 1000 citations to his articles (H index = 18), Scopus lists more than 1500 citations (H index = 22), and Google Scholar lists 2500 citations. He has taught in more than 15 different disciplines at the undergraduate and graduate levels, some disciplines at the graduate level are unpublished, and he aims to present the research conducted, contributing to the creation, consolidation of knowledge, and competence in strategic issues within the areas of teaching and research. He has advised over 25 Ph.D. and M.Sc. students. His interests include the development of methodologies for the operation, planning, and control of electrical power systems, and applications of artificial intelligence in power systems.