

## Modeling and Simulation of Complex Systems Exhibiting Hysteresis

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It is well-known that hysteresis is a phenomenon encountered in many fields of specializations. Examples include magnetic hysteresis in ferromagnetic materials, semiconductor hysteresis in memristors, magnetic as well as critical temperature in superconductors and gear backlash and actuator backlash mechanical hysteresis. Obviously, the ability to accurately model this phenomenon is crucial to the successful design and/or control of any of the aforementioned systems. In general, hysteresis has been best defined as a “multibranch nonlinearity for which branch-to-branch transitions occur after local extrema” where the Preisach model – in its classical and modified forms – have emerged as a mathematically well-defined modeling and simulation option. An important feature of this model is the possibility to realize it in the form of analog electronics, the fact that makes it physically embeddable in hardware control circuits of such complex systems. In this talk, the realization of the Preisach model software- and hardware-wise will be discussed. Examples of its utilization to model and simulate systems exhibiting hysteresis will also be presented.

### Biography

Prof. Adly, received the B.Sc. and M.Sc. degrees in Electrical Power Engineering from Cairo University and the Ph.D. degree in Electrical Engineering from the University of Maryland, College Park, USA. He worked as a Senior Magnetics Scientist at LDJ Electronics, Michigan, USA. He joined Cairo University Faculty of Engineering as an Assistant Professor in 1994 and was promoted to Full Professor in 2004. During the summers of years 1996-2000, Prof. Adly worked as a Visiting Research Professor at the University of Maryland, USA. During the period 1996-2006, Prof. Adly worked a team expert and product development consultant to a number of Egyptian industrial entities. He also worked as a consultant to the UNESCO Cairo office and as an expert to the EU Commission where he participated in developing the 11.2 M Euro Research, Development, and Innovation (RDI) Program for Egypt. In 2006-2007 he established and directed the R&D Division of the Egyptian Industrial Modernization Center (IMC) and was responsible for managing a 100 Million LE Fund to boost the national value-added of Egyptian SMEs. In the period 2010-2019 Prof. Adly was appointed as Cairo University Faculty of Engineering Vice Dean for Education and Students Affairs, Vice Dean for Graduate Studies and Research, the Executive Director of the Science and Technology Development Fund (STDF), Cairo University Vice President for Graduate Studies and Research, and the Deputy Minister of Higher Education and Scientific Research for Universities Affairs. Adly authored two books, published more than 135 reviewed papers, holds one U.S. patent, chaired many sessions in international conferences, and served as the Principal Investigator of several joint international research projects. He is currently the Editor-in-Chief of IEEE Transactions on Magnetics and is an Associate Editor for Elsevier Journal of Advanced Research and Springer Journal of Engineering and Applied Science. Prof. Adly has been awarded many prizes including the Presidential Egyptian First Class Medal of Science and Arts, the University of Maryland ECE Dept. Distinguished Alumni Award, the Egyptian State Appreciation Prize in Engineering Sciences, the Egyptian State Excellence Prize in Engineering Sciences, the Shoman Foundation Arab Scientist Prize and the Egyptian State

Encouragement Prize in Engineering Sciences. He has also been promoted to the prestigious IEEE Fellow status in 2011. Prof. Adly started his role as E-JUST President in July 1<sup>st</sup>, 2022.