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Title: Analysis and Control of Logical Systems

Biography

Dr. Daizhan Cheng graduated from Tsinghua University in 1970, received M.S. from Graduate School, CAS in 1981, and Ph.D. from Washington University, St. Louis, in 1985. Since 1990, he is a professor with Institute of Systems Science, AMSS, Chinese Academy of Sciences. His research interests include nonlinear control systems, switched systems, Hamiltonian systems and Boolean control networks. He is the author/coauthor of 11 Books, over 200 Journal Papers (including over 100 SCI papers) and over 100 Conference Papers. He was Chairman of Technical Committee on Control Theory, CAA (2003-2010). He is IEEE Fellow, IFAC Fellow.

Abstract

We Consider a mapping from a (finite) product of finite sets to another (finite) product of finite sets as a general logical mapping (or logical system). The mappings could be Boolean type (standard logical mapping), multi-valued type (multi-valued logical mapping), or mix-valued type (mix-valued logical mapping). They could be used to describe the Boolean functions for Cryptography, the dynamics of Boolean networks or multi-valued logical networks, and the finite memory strategies in Game Theory, etc. Using semi-tensor product, they can be expressed as algebraic static or dynamic systems. Then the analysis of the topological structure of such systems and the control designs can be handled via their algebraic forms.

This talk first reviews the various backgrounds of the logical systems. Then the semi-tensor product of matrices is introduced as a fundamental tool of this approach. Using it, the algebraic form of logical systems is presented and the different logical systems are expressed into such algebraic form. Some important structures of the Boolean functions in cryptography, and the Boolean networks, etc. are analyzed via their algebraic forms. Finally, some control problems are investigated, which include the controllability, observability, disturbance decoupling, etc. of Boolean and multi-valued networks, the optimization in games, etc.

In short, the talk will provide a general framework and a universal technique to deal with the logical systems, which exist in various disciplines.