北京理工大學

数学与统计学院学术报告

Edge-subset Lattice and Its Application to Linear Network Error Correction Coding

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摘要： In this talk, we first explore the underlying mathematical structure of edge subsets on a finite directed acyclic graph in using a lattice-theoretic approach. We prove that a collection of edge subsets with certain conditions, associated with the corresponding “cut-separating” partial order, forms a (semi-)lattice. The bottom and top thus derived generalize the concept of the primary minimum cut introduced by Guang and Yeung (2018) and hence we provide a new way from a lattice-theoretic point of view to understand the primary minimum cut and to justify its existence and uniqueness. We further develop efficient algorithms to find the top and the bottom, whose computational complexity is in a linear time of the number of edges in the graph. The introduced concepts and obtained results regarded as a bridge connect graph theory and lattice theory, which appear to be of fundamental interest in graph theory, lattice theory, and even beyond. In addition, by applying the approach of the edge-subset (semi-)lattice, we obtain an improved upper bound on the minimum required field size for the existence of linear network error correction (LNEC) codes. In LNEC coding, the minimum required field size for the existence of LNEC (MDS) codes is an open problem not only of theoretical interest but also of practical importance. We quantify the improvement over the existing results by both theoretical analysis and numerical simulations and thus show that the improvement is in general significant.

简介： 光炫博士，南开大学数学科学学院教授，数学学科学术委员会委员、教育部“核心数学与组合数学”重点实验室固定研究人员；入选国家青年人才项目、香江学者计划和南开大学百名青年学科带头人培养计划。2012年毕业于南开大学陈省身数学研究所，获博士学位，曾在美国南加州大学及香港中文大学从事研究工作近5年。研究兴趣为信息论、编码理论与密码学；目前的研究方向为面向函数计算的信息论和编码。近年来出版一部学术专著（一作），由德国Springer出版；发表学术论文60余篇，其中在信息论、安全和通信理论的权威期刊和会议上发表论文30余篇，包括IEEE Trans. Inf. Theory, IEEE J. Sel. Areas Inf. Theory, IEEE J. Sel. Areas Commun., IEEE Trans. Inf. Foren. Sec., USENIX Security,《中国科学》等，研究成果获多个国内外会议的最佳论文奖。2021获天津数学与统计“青年学者奖”；2018 年获得中国电子学会“信息论青年新星奖”；2016 年获“香江学者奖”等。主持重点研发计划课题、基础加强重点研究课题、基金委国际合作研究项目等省部级基金项目9项，企业科技项目2项，获田家炳教育基金资助。

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