报告题目： **System Identification with poor data in Network Era**

报 告 人：王庆国教授，南非国家科学院院士

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矿山智能采掘装备省部共建协同创新中心
矿山智能采掘装备学科创新引智基地

报告摘要：

System identification is making a model for the dynamic system from its input-output data and is important for system analysis, design and control. It is well established with good data in local systems, but faces great challenges for big but poor data in network systems due to sensor faults, energy shortage and communication errors. This talk details one approach to system identification with outliers and briefs recent attempts to solve other poor data issues.

1. The outlier detection problem for dynamic systems is formulated as a matrix decomposition problem with low-rank and sparse matrices, and further recast as a semidefinite programming (SDP) problem. A fast algorithm is presented to solve the resulting problem while keeping the solution matrix structure and it can greatly reduce the computational cost over the standard interior-point method. The computational burden is further reduced by proper construction of subsets of the raw data without violating low rank property of the involved matrix. The proposed method can make exact detection of outliers in case of no noise in output observations. In case of noise, a novel approach based on under-sampling with averaging is developed to denoise while retaining the saliency of outliers, and so-filtered data enables successful outlier detection with the proposed method while the existing filtering methods fail. Use of recovered “clean”" data from the proposed method can give much better parameter estimation compared with that based on the raw data.

2. The traditional framework uses all data equally. This implies, maybe unconsciously, that data come from the same statistic distributions. This may be often unrealistic in practice. Outliers fail distributions and can destroy parameter estimation. In general, the data can have different qualities, distributions and Noise-Signal ratio and they should be used with different weights in the weighted least squares, which however needs statistic distribution of data errors a prior. The issue is to how to determine data statistic properties before they are used in system identification. We use renormalization group method and others. Noise is always present and a threat for good modelling, but accurate parameter estimation is always desired from inevitable noisy data. We attempt to obtain exact parameter estimation with noisy data using the new matrix decomposition method.

报告人简介：

王庆国于 1982，1984，1987 年分别获得学士学位(化工自动化)，硕士学位(工业自动化)，博士学位(工业自动化)及“优秀毕业生”称号。1987 至 1989 年于浙大流体传动与控制国家重点实验室从事博士后研究，1989 年任浙大化工系副教授。1990 年获中国科协“青年科技奖”及国家教委“有突出贡献的博士学位获得者”称号。1990 至 1992 年获德国洪堡研究奖学金在杜伊斯堡大学和卡塞尔大学进行客座研究。1992 至 2015 年任教于新加坡国立大学电气与计算机工程系，2004 年晋升正教授。2015 至 2020 年任南非约翰内斯堡大学智能系统研究院杰出教授，南非国家 A1 级科学家，南非国家科学院院士。自 2020 年起，担任北师大-浸大联合国际学院讲座教授，北京师范大学人工智能与未来网络研究院教授。他的学术领域为自动化/人工智能，主要从事复杂系统的建模、估计、预测、优化、控制等方面的研究。应用领域包括工业与环境过程、能源系统、航空与国防工程、医疗工程，金融市场，农业和渔业；他的工作涵盖了工业 4.0 的核心。在国际杂志发表论文 360 余篇，由 Springer 出版 7 部学术专著，累计论著引用 21000 次，H-index 为 80。荣获国际自控界权威学报《Automatica》 2006-2010 年最多引用论文奖，在 2013 年名列 Thomson Reuters list of highly cited researchers 榜，2014 年荣获《控制理论与应用》创刊 30 周年最具影响力论文奖，每年名列斯坦福大学发布的全球前 2%顶尖科学家“终身科学影响力”和“年度科学影响力”榜单前 1/5，中国全球学者库网站 2022 “全球顶尖前 10 万科学家”前 1/4，入选国际学术网站 Research.com 2023 世界顶级科学家榜单电子与电气工程前 500 名顶级科学家。他也从事大量高技术研发及实际的工程应用，如造纸机、注塑机、间隙过程、飞机、无人机、风能、电厂、机器人、超净室、空调系统及医疗过程等的建模和控制，与许多国际控制大公司合作过，累计科研经费超亿人民币。荣获 2017 年度常州科教城“国家级人才奖”。获美国等地专利 12 项(转让 2 项)。曾任美国电气与电子工程师协会新加坡控制分会主席(4 次)，亚洲控制会议及若干 IEEE 国际会议总主席，国际自动控制联合会学报《过程控制》编委。现任国际著名学报《ISA Transactions》执行副主编(Deputy Editor-in-Chief)，及多份国际学报编委。指导博士生约 40 名，博士后约 30 名。