

## 李增祥博士 (Dr. SHAWN LI ZENGXIANG)

国籍: 中国

籍贯: 福建客家人

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### 教育背景

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|----|---|-------|------------|
| 博士 | 南洋理工大学 (NTU), 计算机科学与工程学院                                | 新加坡   | 2006-2012  |
|    | 博士论文: 高效和容错的分布式仿真<br>导师: 蔡文桐教授 和 Stephen John Turner 教授 |       |            |
| 硕士 | 上海交通大学 (SJTU), 信息安全学院                                   | 上海-中国 | 2003- 2006 |
|    | 硕士论文: 动态二进制翻译和优化<br>导师: 管海兵教授和白英彩教授                     |       |            |
| 学士 | 上海电力大学 (SUEP), 计算机专业                                    | 上海-中国 | 1999-2003  |

### 工作经历

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|-----------------|-------|------------------|
| 2020年8月-现在      | 常务副院长 | 新奥新智数字技术研究院      |
| 2018年4月-2020年8月 | 研究组组长 | 新加坡科研局高性能计算研究所   |
| 2012年6月-2020年8月 | 科学家   | 新加坡科研局高性能计算研究所   |
| 2010年8月-2012年6月 | 助理研究员 | 南洋理工大学并行和分布式计算中心 |

### 研究领域

联邦学习、隐私保护计算、区块链、迁移学习、自监督学习、知识蒸馏、强化学习  
大数据分析、图论计算、时空数据处理、运筹优化算法  
工业互联网、并行分布式计算、数据中心、边云计算  
能源数智化、智能制造、设备智能运维、智能交通和城市、基因精准医疗

### 近期获奖荣誉

- “新奥新智恩牛网联合学习”中国信息通信研究院“联邦学习基础功能”测试 2022 年
- “基于 5G+AIoT 的燃气长输管道调压站安全监管创新应用”中国信息通信研究院“能源领域 5G 应用优秀案例” 2022 年
- “联合学习双向知识蒸馏技术”新奥集团技术发明三等奖 2022 年
- FL-AAAI'2022 最佳应用论文、FL-IJCAI'2022 创新论文奖、IAAI'2023 国际先进人工智能协会应用部署奖
- Grab 公司人工智能应用挑战赛“交通管理和需求预测” 前十解决方案 (1200 参与者) 2019 年
- 亚马逊产学研项目基金“区块链和物联网大数据分析在细粒度可信交通保险的应用” (20000 美元), 2019 年

## **联盟组织和标准制定**

联邦学习产业发展联盟副理事长单位

中国信息通信研究院隐私保护计算联盟成员

自动化学会联邦数据和联邦智能专委会委员

南洋理工大学可信联邦学习研究实验室国际合作伙伴

**IEEE Std 3652.1™-2020**, “IEEE Guide for Architectural Framework and Application of Federated Machine Learning” Published

**IEEE Std 2894™**, “IEEE Guide for an Architectural Framework for Explainable Artificial Intelligence” Approved

中国通信标准化协会, “隐私计算跨平台互联互通 第3 部分: 互联协议”, 修订中

## **新奥新智数字技术研究院**

**北京, 中国 (2020 年 8 月到现在)**

新奥新智数字技术研究院（数研院）致力于产业互联网数据智能研究，推动企业数智化转型。近年来，数研院聚焦行业人工智能和联合学习核心技术，研发成果丰硕，累计申请四百余项发明专利，发表十余篇高质量论文并在国际会议获奖，参与多项技术标准制定。

带领约 50 人的研发团队，聚焦工业互联网、人工智能、联合学习、隐私计算等前沿技术研究和数据智能平台开发。推动研发成果在能源分销运营，供应链优化、能源安全管理、综合能源优化、智城智家、健康生活等新奥核心业务场景落地应用。参与集团技术发展战略制定和推动产学研合作，利用新奥的场景和数据优势，建立联合学习研发合作生态，树立工业应用标杆案例，参与多个产业联盟和多项技术标准制定。

### **主要研究和项目：**

#### **❖ 行业人工智能技术研究**

从新奥集团核心业务场景智能需求出发，研究基于多模态的数据智能算法，包括基于时序数据的预测算法，基于物联数据的异常检测和故障诊断算法，基于图像、视频和特种设备成像的计算机视觉算法，基于贝叶斯网络和知识图谱的认知智能算法，基于运筹学、仿生学和强化学习等决策优化算法。同时致力于人工智能前沿技术研究，包括产业基础模型预训练、迁移学习和自适应学习，自监督学习，模型压缩和边云协同部署，以及模型可解释性和可信人工智能等。

#### **❖ 联合学习技术研究**

在保护数据主权和隐私安全的前提下，共同挖掘数据背后价值，共建产业智能生态。支持多种机器学习和深度学习的联合学习算法和自适应的模型聚合策略。利用知识蒸馏、迁移学习、自监督学习、难样本选择、相似数据聚类先进人工智能技术降低联合学习通信开销，提高边云协同效率，支持生态伙伴使用异构的数据、系统和模型，高效共创优质 AI 模型。采用安全多方计算、同态加密、可信执行环境和差分隐私等隐私保护技术，保障安全等级的同时降低计算和通信开销。通过分配激励机制衡量参与方对智能模型的贡献，鼓励贡献高价值数据，激励产业生态互信合作、公平竞争和可持续发展。

依托新奥集团在能源等领域的行业优势，建立产学研生态合作体系，搭建智能算法开

发部署平台和跨企业的联合学习试验平台。阶段性研发成果在新奥能源领域核心应用场景中得到实验验证和落地应用。

#### ❖ 产业互联网应用场景

燃气负荷预测:利用纵向联合学习安全使用客户生产计划和行业知识,横向联合学习合规打通多家城燃公司的海量客户数据,多变量时序数据对比自监督学习等技术,共创负荷预测产业智能模型,提升客户气量需求预测精度和聚集效率,优化燃气分销运营和供应链管理。

智城智家社区智能安全场景:利用联合学习技术安全合规打通物业公司、燃气公司、供热公司、政府部门等多方数据,支持联合隐私计算和联合产业建模,为生态合作提供数据和算法基础。例如掌握住户生活习惯和精准画像支持更加高效安全管理,利用多方图片和视频数据训练智能模型识别户内、公共区域、工商户等安全隐患。

设备运维异常和故障诊断场景:机理分析算法和人工智能算法相结合构建统一设备运维智能管理系统,提出云边协同的异构模型联合学习框架,吸引具有不同数据和算力资源的工厂、设备厂商、传感器厂商、高校实验室,共建开放包容的合作生态,解决设备故障数据稀缺和智能应用冷启动难等问题,提升产业整体智能水平。

#### **新加坡科研局高性能计算研究所 新加坡 (2012年6月-2020年8月)**

带领约15人的研发团队,负责(PI)和联合负责(Co-PI)多个有影响力的研究和工业项目,在并行和分布式系统,大数据分析,城市计算,区块链和可信计算等方向深入研究。通过与大学院所、政府部门、跨国企业的合作,推动研究成果在城市交通、智能制造、智能精准医疗、数据中心等领域应用。

#### **主要研究和项目:**

#### ❖ 新加坡科研局 SERC 战略研究基金 (2020年1月到2020年12月)

联合主管“可信数据要素流通”项目,研究和融合区块链、安全多方计算、联邦学习等前沿技术,支持跨组织安全数据共享和隐私保护联合学习,探索在医疗、交通、保险、海运、制造业等领域的应用。

主要合作伙伴:资讯通信研究所,生物医学研究理事会,计算资源中心

#### ❖ 新加坡和德国学术和工业 (2+2) 国家合作研究计划 (2020年1月到2021年12月)

主管“基于区块链的可信供应链”项目,研发融合区块链和隐私保护计算技术的供应链监管框架,支持透明、高效和可信的个人消费品跨组织供应链。

主要合作伙伴:金佰利公司,德国弗劳恩霍夫协会,德国技术监督协会。

#### ❖ 工业合作项目:“透明高性能计算”角色:核心人员 (2020年3月到2022年2月)

利用大数据分析和机器学习算法,优化数据中心自适应计算资源调度,支持大规模高性能计算任务,包括精准医疗基因计算和流体力学仿真等。

主要合作伙伴:新加坡科研局计算资源中心,富士通

#### ❖ 新加坡基因研究所合作项目 (2019年10月到2021年10月)

联合负责“面向国家精准医疗的可扩展高性能计算和机器学习分析系统”项目，研发云原生数据分析平台支持大规模基因计算和医疗数据分析。

主要合作伙伴:新加坡科研局基因研究所, 新加坡保健集团

❖ **新加坡科研局工业物联网创新平台（2018年10月到2021年10月）**

主管“安全互通平台和互信合作机制”项目，负责多种商用工业物联网平台的互联互通性研究与应用，建立基于区块链技术的跨组织和上下游供应链互信合作机制。

主要合作伙伴:劳斯莱斯、亚马逊

❖ **智能制造联合实验室（2018年2月到2020年12月）**

联合主管“工业物联网和共享服务”项目，负责边缘、本地和云计算相融合的物联网平台和解决方案，机器学习算法和云原生微服务在制造业的应用。

主要合作伙伴:劳斯莱斯

❖ **新加坡城市计算与工程卓越中心（2015年6月到2018年5月）**

主管“大规模数据处理”项目，负责高速并行的大规模城市级别时空数据处理和分析工具，以及研究基于图论的城市计算，探索城市医疗等资源规划、多模态交通连接性、需求和到达时间预测、电召车和出租车行为分析、校车和救护车调度等方面的应用。

主要合作伙伴:富士通和新加坡陆交局。

❖ **新加坡科研局未来数据中心技术研究计划（2012年8月到2015年1月）**

联合主管“多用户数据中心自适应综合资源调度”项目，负责虚拟计算资源的自适应调度，支持高效率并行分布式应用和节能数据中心。

主要合作伙伴:新加坡科研局数据存储研究所，新加坡国立大学

## 主要论文（新奥新智数字技术研究院）

### 期刊论文:

1. Chengyi Yang, Jia Liu, Hao Sun, Tongzhi Li and **Zengxiang Li**, “WTDP-Shapley: Efficient and Effective Incentive Mechanism in Federated Learning for Intelligent Safety Inspection”, IEEE Transactions on Big Data, IF 4.271, 2022, Accepted
2. Chi Zhang, Soththiwat Ekant, Liangli Zhen, **Zengxiang Li**, “Augmented Multi-Party Computation for Secure Federated Learning” IEEE Transactions on Big Data, IF 4.271, 2022, Accepted
3. Renuga Kanagavelu, Qingsong Wei; **Zengxiang Li**; Haibin Zhang; Juniarto Samsudin; Yechao Yang; Rick Siow Mong Goh; Shangguang Wang, “CE-Fed: Communication Efficient Multi-party Computation Enabled Federated Learning” ARRAY 2020 Open Access
4. Weishan Zhang, Fa Yu, Xiao Wang, Xingjie Zeng, Hongwei Zhao, Zenglin Tian, Fei-Yue Wang, Hongwei Qi, **Zengxiang Li**, “R2Fed: Resilient Reinforcement Federated Learning for Industrial Applications”, IEEE Transactions on Industrial Informatics, IF 10.215, 2022, Accepted

### 会议论文:

1. Chengyi Yang, Jia Liu, Hao Sun, Tongzhi Li and **Zengxiang Li**, “WT-Shapley: Efficient and Effective Incentive Mechanism in Federated Learning for Intelligent Safety Inspection”, FL-AAAI 2022, **Best Application Award**
2. Sheng Guo, **Zengxiang Li**, Hui Liu, Shubao Zhao and Cheng Hao Jin, “Personalized Federated Learning for Multi-task Fault Diagnosis of Rotating Machinery” FL-AAAI 2022
3. Lianlian Jiang, Yuexuan Wang, Wenyi Zheng, Chao Jin, Zengxiang Li, Sin G. Teo, “LSTMSPLIT: Effective SPLIT Learning based LSTM on Sequential Time-Series Data”, FL-AAAI 2022
4. Shubao Zhao, Jia Liu, Guoliang Ma, Jie Yang, Di Liu and **Zengxiang Li**, “Cluster-driven Personalized Federated Learning for Natural Gas Load Forecasting” FL-IJCAI 2022, **Innovation Award**
5. Yuanyuan Chen, Zichen Chen, Yansong Zhao, Zelei Liu, Pengcheng Wu, Sheng Guo, Chengyi Yang, **Zengxiang Li** and Han Yu, “Efficient Training of Large-scale Industrial Fault Diagnostic Models through Federated Opportunistic Block Dropout” The 35th Annual Conference on Innovative Applications of Artificial Intelligence (IAAI-23) AI deployment award
6. Hanchi Shen, Jun Li, Kang Wei, Pengcheng Xia, Sirui Tian, Ming Ding, **Zengxiang Li**, “CluFL: Cluster-driven Weighted FL Model Aggregation Strategy”, The 28th IEEE International Conference on Parallel and Distributed Systems (ICPADS 2022), Accepted

## 主要论文（新加坡科研局高性能计算研究所）

### 期刊论文:

1. Tien-En Tan, Ayesha Anees, Cheng Chen, Shaohua Li, Xinxing Xu, **Zengxiang Li**, Tien Yin Wong, Yong Liu, Daniel Shu Wei Ting, et, al. “Retinal Photograph-Based Deep Learning Algorithms for Myopia and a Blockchain Platform to Facilitate Artificial Intelligence Medical Research: A Retrospective Multi-Cohort Study” The Lancet Digital Health, Mar, 2021 (Editor’s Pick)
2. Palina Tolmach, Yi Li, Shang-Wei Lin, Yang Liu, **Zengxiang Li** “A Survey of Smart Contract Formal Specification and Verification” ACM Computing Surveys, Mar, 2021
3. Chi Zhang Soththiwat Ekanut; Liangli Zhen; Joey Tianyi Zhou; **Zengxiang Li** “Augmented Multi-Party Computation Against Gradient Leakage in Federated Learning”. IEEE Transactions on Big Data, 2022.
4. Yang Zhao, Jun Zhao, Linshan Jiang, Rui Tan, Dusit Niyato, **Zengxiang Li**, Lingjuan Lyu, and Yingbo Liu “Privacy-Preserving Blockchain-Based Federated Learning for IoT Devices” IEEE Internet of Things Journal, 2020
5. Zhe Xiao, **Zengxiang Li**, Yechao Yang, Yauheni Pyrlokh, Ekanut Soththiwat and Rick Siow Mong Goh, “Blockchain and IoT for Insurance: A Case Study and Cyberinfrastructure Solution on Fine-grained Transportation Insurance” Transactions on Computational Social System, 2020
6. Renuga Kanagavelu, **Zengxiang Li**, Juniarto Samsudin, Shaista Hussain, Yang Yechao, Yang Feng, Goh Siow Mong, Rick, Mervyn Cheah “Federated Learning for Advanced Manufacturing Based on



- Industrial IoT Data Analytics” Book chapter of “The Model Factory as the key enabler for the Future of Manufacturing”. Part of Book Series “Intelligent Systems Reference Library”, Springer-Verlag, 2020
7. Eda Koksai Ahmed, **Zengxiang Li**, Bharadwaj Veeravalli and Shen Ren, “Reinforcement Learning enabled Genetic Algorithm for Vehicle Fleet Scheduling” Journal of Intelligent Transportation Systems, 2020
  8. Bo Yang, Shen Ren, Erika Legara, **Zengxiang Li**, Edward Ong, Louis Lin and Christophe Monterola, “Phase Transition in Taxi Dynamics and Impact of Ridesharing” Transportation Science, 2019
  9. Quanqing Xu, Zhaozheng He, **Zengxiang Li**, Mingzhong Xiao, Rick Siow Mong Goh, Yongjun Li “An Effective Blockchain-based Decentralized Application for Smart Building System Management”, book chapter of “Real-Time Data Analytics for Large-Scale Sensor Data”, Elsevier 2019
  10. **Zengxiang Li**, Shen Ren, Nan Hu, Yong Liu, Zheng Qin, Rick Siow Mong Goh, Liwen Hou, Bharadwaj Veeravalli, “Equality of Public Transit Connectivity: The Influence of MRT Services on Individual Buildings for Singapore”, Transportmetrica B: Transport Dynamics, 2018
  11. Yulin Wu, Wentong Cai, **Zengxiang Li**, Xiangting Hou, Wen Jun Tan, “Efficient Parallel Simulation over Large-scale Social Contact Networks”, ACM Trans. on Modeling and Computer Simulation, 2018
  12. **Zengxiang Li**, Wentong Cai, Stephen John Turner, Zheng Qin, Rick Siow Mong Goh, “Transparent three-phase Byzantine fault tolerance for parallel and distributed simulations”, Simulation Modelling Practice and Theory
  13. **Zengxiang Li**, Wentong Cai, Stephen John Turner, Xiaorong Li, Ta Nguyen Binh Duong, Rick Siow Mong Goh, “Adaptive Resource Provisioning Mechanism in VEEs for Improving Performance of HLA-Based Simulations” ,ACM Transactions on Modeling and Computer Simulation
  14. **Zengxiang Li**, Wentong Cai, Stephen John Turner, “Un-identical federate replication structure for improving performance of HLA-based simulations”, Simulation Modelling Practice and Theory

## 会议论文:

1. Ekanut Soththiwat, Liangli Zhen, **Zengxiang Li**, Chi Zhang, “Partially Encrypted Multi-Party Computation for Federated Learning”, NEAC workshop IEEE/ACM International Symposium on Cluster, Cloud and Internet Computing (CCGrid 2021)
2. Huafei Zhu, **Zengxiang Li**, Mervyn Cheah, Rick Siow Mong Goh, “Privacy-preserving Weighted Federated Learning within Oracle-Aided MPC Framework” arXiv:2003.07630
3. Qi Feng, Debiao He, **Zengxiang Li**, Li Li, Kim-Kwang Raymond Choo, “Practical Secure Two-Party EdDSA Signature Generation with Key Protection and Applications in Cryptocurrency” IEEE International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom 2020)
4. Jun Zhao, Jing Tang, **Zengxiang Li**, Huaxiong Wang, Kwok-Yan Lam, Kaiping Xue, “An Analysis of Blockchain Consistency in Asynchronous Networks: Deriving a Neat Bound”, IEEE International Conference on Distributed Computing Systems (ICDCS 2020),
5. Renuga Kanagavelu, **Zengxiang Li**, Juniarto Samsudin, Yechao Yang, Feng Yang, Rick Siow Mong Goh, Mervyn Cheah, Praewpiraya Wiwatphonthona, Khajonpong Akkarajitsakul and Shangguang Wang, “Two-Phase Multi-Party Computation Enabled Privacy-Preserving Federated Learning” IEEE/ACM International Symposium on Cluster, Cloud and Internet Computing (CCGrid 2020)
6. **Zengxiang Li**, Chutima Kitcharoenpaisan, Phond Phunchongharnb, Yechao Yang, Rick Siow Mong Goh, and Yusen Li, “Efficient Multi-Party Computation Algorithm Design For Real-World Applications”, International Workshop on Emerging Topic in Computer Science (ETCS 2019)
7. Xi Lin, Yequan Wang, Xiaokui Xiao, **Zengxiang Li** and Sourav S. Bhowmick “Path Travel Time Estimation using Attribute-related Hybrid Trajectories Network”, ACM International Conference on Information and Knowledge Management (CIKM’19)
8. **Zengxiang Li**, Zhe Xiao, Quanqing Xu, Ekanut Soththiwat, Rick Siow Mong Goh and Xueping Liang, “Blockchain and IoT Data Analytics for Fine-grained Transportation Insurance”, International Workshop on Blockchain Technologies and Systems (BCTS’18) 2018 Best Paper Runner Up
9. Zhe Xiao, **Zengxiang Li**, Yong Liu, Ling Feng, Weiwen Zhang, Thanarit Lertwuthikarn and Rick Siow Mong Goh, “EMRShare: A Cross-organizational Medical Data Sharing and Management Framework Using Permissioned Blockchain”, International Workshop on Blockchain Technologies and Systems (BCTS’18) 2018

10. Quanqing Xu, Zhaozheng He, **Zengxiang Li** and Mingzhong Xiao, "Building an Ethereum-based Decentralized Smart Home System", International Workshop on Blockchain Technologies and Systems (BCTS'18) 2018
11. Weiwen Zhang, Yong Liu, Long Wang, **Zengxiang Li** and Rick Siow Mong Goh, "Cost-Efficient and Latency-Aware Workflow Scheduling Policy for Container-based Systems", IEEE International Conference on Parallel and Distributed Systems (ICPADS'18) 2018
12. **Zengxiang Li**, Shen Ren, Sifei Lu, Jiachun Guo, Wentong Cai, Zheng Qin and Rick Siow Mong Goh, "Concurrent Hybrid Breadth-First-Search on Distributed PowerGraph for Skewed Graphs", IEEE International Conference on Parallel and Distributed Systems (ICPADS'18) 2018
13. Shen Ren, Bo Yang, Liye Zhang and **Zengxiang Li**, "Traffic Speed Prediction with Convolutional Neural Network Adapted for Non-linear Spatio-temporal Dynamics" ACM SIGSPATIAL International Workshop on analytics for Big Geospatial Data (BigSpatial 2018)
14. Xi Lin, Xiaokui Xiao, **Zengxiang Li**, "A Scalable Approach to Inferring Travel Time in Singapore's Metro Network using Smart Card Data" IEEE International Smart Cities Conference (ISC2 2018)
15. Yuhong Feng, Meihong Guo, Kezhong Lu and Zhong Ming (Shenzhen University, China); Haoming Zhong (Webank, China); Wentong Cai (NTU, Singapore); **Zengxiang Li** (IHPC, Singapore), "Optimize the FP-tree based Graph Edge Weight Computation on Multi-core MapReduce Clusters", IEEE International Conference on Parallel and Distributed Systems (ICPADS'17) 2017
16. Shen Ren, Lin Han, **Zengxiang Li**, Bharadwaj Veeravalli, "Spatial-temporal Traffic Speed Bands Data Analysis and Prediction", IEEE International Conference on Industrial Engineering and Engineering Management (IEEM'17) 2017 (Honorable Mention Award)
17. Sifei Lu, **Zengxiang Li**, Zhen Qin, Xulei Yang, Rick Siow Mong GOH, "A Hybrid Regression Technique for House Prices Prediction", IEEE International Conference on Industrial Engineering and Engineering Management (IEEM'17) 2017
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## 主要论文（新加坡南洋理工大学博士和助理研究员）

### 期刊论文:

1. **Zengxiang Li**, Xueyan Tang, Wentong Cai, Xiaorong Li, “Compensatory dead-reckoning-based update scheduling for distributed virtual environments”, Simulation
2. **Zengxiang Li**, Wentong Cai, Xueyan Tang, Suiping Zhou, “Loss-aware DR-based update scheduling for improving consistency in DVEs”, Journal of Simulation
3. Ke Pan, Stephen John Turner, Wentong Cai, **Zengxiang Li**, “A dynamic sort-based DDM matching algorithm for HLA applications”, ACM Transactions on Modeling and Computer Simulation
4. **Zengxiang Li**, Wentong Cai, Stephen John Turner, Ke Pan, “A replication structure for efficient and fault-tolerant parallel and distributed simulations”, Proceedings of the 2010 Spring Simulation Multiconference
5. Ke Pan, Stephen John Turner, Wentong Cai, **Zengxiang Li**, “A hybrid HLA time management algorithm based on both conditional and unconditional information”, Simulation

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12. Ke Pan, Stephen John Turner, Wentong Cai, **Zengxiang Li**, “A service oriented HLA RTI on the grid”, IEEE International Conference on Web Services (ICWS 2007)
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