2022 IEEE International Parallel and Distributed Processing Symposium (IPDPS 2022)

Virtual Conference 30 May - 3 June 2022

Pages 1-682



IEEE Catalog Number: CFP22023-POD ISBN:

978-1-6654-8107-6

Copyright © 2022 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

 IEEE Catalog Number:
 CFP22023-POD

 ISBN (Print-On-Demand):
 978-1-6654-8107-6

 ISBN (Online):
 978-1-6654-8106-9

ISSN: 1530-2075

Additional Copies of This Publication Are Available From:

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA

Phone: (845) 758-0400 Fax: (845) 758-2633

E-mail: curran@proceedings.com Web: www.proceedings.com



2022 IEEE International Parallel and Distributed Processing Symposium (IPDPS)

IPDPS 2022

Table of Contents

lessage from the 2022 General Co-Chairs	xxiii
lessage from the 2022 Program Chairs	xxv
PDPS 2022 Technical Program	. xxvii
PDPS 2022 Organization	xxix
ession 1: Welcome to IPDPS 2022	
ession 2: Keynote 1	
hallenges and Opportunities in Designing High-Performance and Scalable Middleware for PC and AI: Past, Present, and Future	1
ession 3: Algo-1 Linear Algebra TS: A Threaded Multilevel Sparse Hybrid Solver	2
Joshua Dennis Booth (University of Alabama in Huntsville, USA)	
Scalable Adaptive-Matrix SpMV for Heterogeneous Architectures Han D. Tran (University of Utah, USA), Milinda Fernando (University of Texas at Austin, USA), Kumar Saurabh (Iowa State University, USA), Baskar Ganapathysubramanian (Iowa State University, USA), Robert M. Kirby (University of Utah, USA), and Hari Sundar (University of Utah, USA)	13
irect Solution of Larger Coupled Sparse/dense Linear Systems using Low-Rank Compression in Single-Node Multi-core Machines in an Industrial Context	25
O-Optimal Cache-Oblivious Sparse Matrix-Sparse Matrix Multiplication	36

Distributed-Memory Sparse Kernels for Machine Learning
Session 4: SysSoft-1 Memory Management
PokéMem: Taming Wild Memory Consumers in Apache Spark
SSB-Tree: Making Persistent Memory B+-Trees Crash-Consistent and Concurrent by Lazy-Box 70 Tongliang Li (Tsinghua University, China), Haixia Wang (Tsinghua University, China), Airan Shao (Tsinghua University, China), and Dongsheng Wang (Tsinghua University, China)
FAM-Graph: Graph Analytics on Disaggregated Memory
Scalable Multi-versioning Ordered Key-Value Stores with Persistent Memory Support
In-Memory Indexed Caching for Distributed Data Processing
Session 5: Multi-1 GPUs for Mutlidisciplinary Applications
Landau Collision Operator in the CUDA Programming Model Applied to Thermal Quench Plasmas
Mark F. Adams (Lawrence Berkeley National Laboratory, USA), Dylan P. Brennan (Princeton University, USA), Matthew G. Knepley (University at Buffalo, USA), and Peng Wang (NVIDIA Corporation, USA)
Exploiting Reduced Precision for GPU-Based Time Series Mining
MICCO: An Enhanced Multi-GPU Scheduling Framework for Many-Body Correlation Functions 135 Qihan Wang (William & Mary, USA), Bin Ren (William & Mary, USA), Jie Chen (Jefferson Lab, USA), and Robert G. Edwards (Jefferson Lab, USA)
Unlocking Personalized Healthcare on Modern CPUs/GPUs: Three-way Gene Interaction Study 146 Diogo Marques (INESC-ID, Portugal), Rafael Campos (INESC-ID, Portugal), Sergio Santander-Jiménez (University of Extremadura, Spain), Zakhar Matveev (Intel Corporation, Russia), Leonel Sousa (INESC-ID, Portugal), and Aleksandar Ilic (INESC-ID, Portugal)

Batched Sparse Iterative Solvers on GPU for the Collision Operator for Fusion Plasma Simulations
Session 6: Exp-1 GPU Applications
PARSEC: PARallel Subgraph Enumeration in CUDA
Top-Down Performance Profiling on NVIDIA's GPUs
Scaling and Selecting GPU Methods for All Pairs Shortest Paths (APSP) Computations
Parallel Vertex Cover Algorithms on GPUs Peter Yamout (American University of Beirut, Lebanon), Karim Barada (American University of Beirut, Lebanon), Adnan Jaljuli (American University of Beirut, Lebanon), Amer E. Mouawad (American University of Beirut, Lebanon), and Izzat El Hajj (American University of Beirut, Lebanon)
Session 7: Arch-1 Memory Management
SecFortress: Securing Hypervisor using Cross-Layer Isolation

Exploring Efficient Microservice Level Parallelism	3
Scalable Low-Latency Inter-FPGA Networks	Ŀ
A General Offloading Approach for Near-DRAM Processing-In-Memory Architectures	•
Minerva: Rethinking Secure Architectures for the Era of Fabric-Attached Memory Architectures	3
Session 8: Algo-2 Graphs	
Parallel Global Edge Switching for the Uniform Sampling of Simple Graphs with Prescribed Degrees)
Parallel, Portable Algorithms for Distance-2 Maximal Independent Set and Graph Coarsening 280 Brian Kelley (Sandia National Laboratories, USA) and Sivasankaran Rajamanickam (Sandia National Laboratories, USA))
Asynchronous Distributed-Memory Triangle Counting and LCC with RMA Caching	L

Communication-Efficient Massively Distributed Connected Components	302
Mnemonic: A Parallel Subgraph Matching System for Streaming Graphs	313
Session 9: SysSoft-2 System Scheduling	
QoS-Awareness of Microservices with Excessive Loads via Inter-Datacenter Scheduling	324
Resource Utilization Aware Job Scheduling to Mitigate Performance Variability	335
Dynamic Task Shaping for High Throughput Data Analysis Applications in High Energy Physics Benjamin Tovar (University of Notre Dame, USA), Benjamin Lyons (University of Notre Dame, USA), Kelci Mohrman (University of Notre Dame, USA), Barry Sly-Delgado (University of Notre Dame, USA), Kevin Lannon (University of Notre Dame, USA), and Douglas Thain (University of Notre Dame, USA)	s 346
Multi-phase Task-Based HPC Applications: Quickly Learning how to Run Fast	357
DFMan: A Graph-based Optimization of Dataflow Scheduling on High-Performance Computing Systems Fahim Chowdhury (Florida State University, USA), Francesco Di Natale (Lawrence Livermore National Laboratory, USA), Adam Moody (Lawrence	
Livermore National Laboratory, USA), Kathryn Mohror (Lawrence Livermore National Laboratory, USA), and Weikuan Yu (Florida State University, USA)	

Session 10: Multi-2 Scheduling Applications

Parallel Approximations of the Tukey g-and-n Likelihoods and Predictions for Non-Gaussian Geostatistics	379
Secostatistics Sagnik Mondal (King Abdullah University of Science and Technology, Saudi Arabia), Sameh Abdulah (King Abdullah University of Science and Technology, Saudi Arabia), Hatem Ltaief (King Abdullah University of Science and Technology, Saudi Arabia), Ying Sun (King Abdullah University of Science and Technology, Saudi Arabia), Marc G. Genton (King Abdullah University of Science and Technology, Saudi Arabia), and David E. Keyes (King Abdullah University of Science and Technology, Saudi Arabia)	
Parallelizing and Balancing Coupled DSMC/PIC for Large-Scale Particle Simulations	390
Next-Generation Local Time Stepping for the ADER-DG Finite Element Method	402
A Framework to Exploit Data Sparsity in Tile Low-Rank Cholesky Factorization	414
On the Parallel Reconstruction from Pooled Data Oliver Gebhard (TU Dortmund University, Germany), Max Hahn-Klimroth (TU Dortmund University, Germany), Dominik Kaaser (Universität Hamburg, Germany), and Philipp Loick (Goethe University Frankfurt, Germany)	425
Session 11: Exp-2 Scheduling & Optimization	
P-ckpt: Coordinated Prioritized Checkpointing Subhendu Behera (North Carolina State University, USA), Lipeng Wan (Oak Ridge National Laboratory, USA), Frank Mueller (North Carolina State University, USA), Matthew Wolf (Oak Ridge National Laboratory, USA), and Scott Klasky (Oak Ridge National Laboratory, USA)	436
TEE-Based Decentralized Recommender Systems: The Raw Data Sharing Redemption	447

Accuracy vs. Cost in Parallel Fixed-Precision Low-Rank Approximations of Sparse Matrices 4 Robert Ernstbrunner (University of Vienna, Austria), Viktoria Mayer (University of Vienna, Austria), and Wilfried Gansterer (University of Vienna, Austria)	1 59
Hybrid Workload Scheduling on HPC Systems	17 0
Session 12: Models-1 GPU Programming	
GSpecPal: Speculation-Centric Finite State Machine Parallelization on GPUs Yuguang Wang (Michigan Technological University, USA), Robbie Watling (Michigan Technological University, USA), Junqiao Qiu (Michigan Technological University, USA), and Zhenlin Wang (Michigan Technological University, USA)	481
Lightning: Scaling the GPU Programming Model Beyond a Single GPU Stijn Heldens (Netherlands eScience Center, the Netherlands; University of Amsterdam, the Netherlands), Pieter Hijma (University of Amsterdam; Vrije Universiteit Amsterdam, the Netherlands), Ben van Werkhoven (Netherlands eScience Center, the Netherlands), Jason Maassen (Netherlands eScience Center, the Netherlands), and Rob V. van Nieuwpoort (Netherlands eScience Center, the Netherlands; University of Amsterdam, the Netherlands)	192
Co-designing an OpenMP GPU Runtime and Optimizations for Near-Zero Overhead Execution 5 Johannes Doerfert (Argonne National Laboratory, USA), Atemn Patel (University of Waterloo, Canada), Joseph Huber (Oak Ridge National Laboratory, USA), Shilei Tian (Stony Brook University, USA), Jose M Monsalve Diaz (Argonne National Laboratory, USA), Barbara Chapman (Stony Brook University, USA), and Giorgis Georgakoudis (Lawrence Livermore National Laboratory, USA)	504
Bit-GraphBLAS: Bit-Level Optimizations of Matrix-Centric Graph Processing on GPU	515
CSMV: A Highly Scalable Multi-versioned Software Transactional Memory for GPUs	526
Session 13: Keynote 2	
Resilience at Extreme Scale and Connections with Other Domains Leonardo Bautista Gomez (Barcelona Supercomputing Center, Spain)	537

Session 14: Best Paper Candidates

Colza: Enabling Elastic In Situ Visualization for High-Performance Computing Simulations	538
Towards Distributed 2-Approximation Steiner Minimal Trees in Billion-Edge Graphs	549
As Easy as ABC: Optimal (A) Ccountable (B) Yzantine (C) Onsensus is Easy!	560
Understanding the Design-Space of Sparse/Dense Multiphase GNN Dataflows on Spatial Accelerators Raveesh Garg (Georgia Institute of Technology, USA), Eric Qin (Georgia Institute of Technology, USA), Francisco Muñoz-Martínez (Universidad de Murcia, Spain), Robert Guirado (Universitat Politecnica de Catalunya, Spain), Akshay Jain (Neutroon), Sergi Abadal (Universitat Politecnica de Catalunya, Spain), José L. Abellán (Universidad Católica de Murcia, Spain), Manuel E. Acacio (Universidad de Murcia, Spain), Eduard Alarcón (Universitat Politecnica de Catalunya, Spain), Sivasankaran Rajamanickam (Sandia National Laboratories, USA), and Tushar Krishna (Georgia Institute of Technology, USA)	571
"Smarter" NICs for Faster Molecular Dynamics: A Case Study Sara Karamati (Georgia Institute of Technology, USA), Clayton Hughes (Sandia National Laboratories, USA), K. Scott Hemmert (Sandia National Laboratories, USA), Ryan E. Grant (Queen's University, Canada), W. Whit Schonbein (Sandia National Laboratories, USA), Scott Levy (Sandia National Laboratories, USA), Thomas M. Conte (Georgia Institute of Technology, USA), Jeffrey Young (Georgia Institute of Technology, USA), and Richard W. Vuduc (Georgia Institute of Technology, USA)	583
Session 15: Algo-3 Machine Learning	
RLRP: High-Efficient Data Placement with Reinforcement Learning for Modern Distributed Storage Systems Kai Lu (Huazhong University of Science and Technology, China), Nannan Zhao (Northwestern Polytechnical University, China), Jiguang Wan (Huazhong University of Science and Technology, China), Changhong Fei (Huazhong University of Science and Technology, China), Wei Zhao (Sense Time Research, China), and Tongliang Deng (Sense Time Research, China)	595

AxoNN: An Asynchronous, Message-Driven Parallel Framework for Extreme-Scale Deep Learning 606 Siddharth Singh (University of Maryland, USA) and Abhinav Bhatele (University of Maryland, USA)	••••
Fast Parallel Bayesian Network Structure Learning	617
Adaptive Verifiable Coded Computing: Towards Fast, Secure and Private Distributed Machine Learning Tingting Tang (University of Southern California, USA), Ramy E. Ali (University of Southern California, USA), Hanieh Hashemi (University of Southern California, USA), Tynan Gangwani (University of Southern California, USA), Salman Avestimehr (University of Southern California, USA), and Murali Annavaram (University of Southern California, USA)	628
pFedGF: Enabling Personalized Federated Learning via Gradient Fusion	639
	650
Scheduling on Uniform and Unrelated Machines with Bipartite Incompatibility Graphs	661
SPIDER: An Effective, Efficient and Robust Load Scheduler for Real-Time Split Frame Rendering	672
Bounding the Flow Time in Online Scheduling with Structured Processing Sets	683

Memory-Aware Scheduling of Tasks Sharing Data on Multiple GPUs with Dynamic Runtime Systems	694
Maxime Gonthier (ENS-Lyon, France), Loris Marchal (ENS-Lyon, France), and Samuel Thibault (University of Bordeaux, France)	
Session 17: SysSoft-3 GPU Systems	
Accelerating Encrypted Computing on Intel GPUs	705
Optimizing Huffman Decoding for Error-Bounded Lossy Compression on GPUs	717
SALoBa: Maximizing Data Locality and Workload Balance for Fast Sequence Alignment on GPUs Seongyeon Park (Yonsei University, South Korea), Hajin Kim (Yonsei University, South Korea), Tanveer Ahmad (TU Delft, Netherlands), Nauman Ahmed (TU Delft, Netherlands), Zaid Al-Ars (TU Delft, Netherlands), H. Peter Hofstee (TU Deflt, Netherlands, IBM, United States of America), Youngsok Kim (Yonsei University, South Korea), and Jinho Lee (Yonsei University, South Korea)	728
DGSF: Disaggregated GPUs for Serverless Functions	739
Compiler-Directed Incremental Checkpointing for Low Latency GPU Preemption	751
Session 18: Multi-3 Graphs & Massive Data	
ParaTreeT: A Fast, General Framework for Spatial Tree Traversal Joseph Hutter (University of Illinois at Chicago, USA), Justin Szaday (University of Illinois at Chicago, USA), Jaemin Choi (University of Illinois at Chicago, USA), Simeng Liu (University of Illinois at Chicago, USA), Laxmikant Kale (University of Illinois at Chicago, USA), Spencer Wallace (University of Washington, USA), and Thomas Quinn (University of Washington, USA)	762

An Integral-Equation-Oriented Vectorized SpMV Algorithm and Its Application on CT Imaging Reconstruction	73
High-Order Line Graphs of Non-Uniform Hypergraphs: Algorithms, Applications, and Experimental Analysis	84
Topological Modeling and Parallelization of Multidimensional Data on Microelectrode Arrays 79. Olamide Tawose (University of Nevada, Reno, USA), Bin Li (University of Nevada, Reno, USA), Lei Yang (University of Nevada, Reno, USA), Feng Yan (University of Nevada, Reno, USA), and Dongfang Zhao (University of Nevada, Reno, USA)	95
Coupling Streaming AI and HPC Ensembles to Achieve 100-1000× Faster Biomolecular Simulations	06
Session 19: Models-2 Programming Models	
Neon: A Multi-GPU Programming Model for Grid-Based Computations	17

OmpSs@cloudFPGA: An FPGA Task-Based Programming Model with Message Passing Juan Miguel de Haro (Barcelona Supercomputing Center, Spain; Universitat Politècnica de Catalunya, Spain), Rubén Cano (Barcelona Supercomputing Center, Spain), Carlos Álvarez (Barcelona Supercomputing Center, Spain; Universitat Politècnica de Catalunya, Spain), Daniel Jiménez-González (Barcelona Supercomputing Center, Spain; Universitat Politècnica de Catalunya, Spain), Xavier Martorell (Barcelona Supercomputing Center, Spain; Universitat Politècnica de Catalunya, Spain), Eduard Ayguadé (Barcelona Supercomputing Center, Spain; Universitat Politècnica de Catalunya, Spain), Jesús Labarta (Barcelona Supercomputing Center, Spain; Universitat Politècnica de Catalunya, Spain), Francois Abel (IBM Research Europe, Switzerland), Burkhard Ringlein (IBM Research Europe, Switzerland), and Beat Weiss (IBM Research Europe, Switzerland)	828
Joseph Schuchart (The University of Tennessee, USA), Poornima Nookala (Stony Brook University, USA), Mohammad Mahdi Javanmard (Meta Platforms, Inc, USA), Thomas Herault (The University of Tennessee, USA), Edward F. Valeev (Virginia Polytechnic Institute and State University, USA), George Bosilca (The University of Tennessee, USA), and Robert J. Harrison (Stony Brook University, USA)	839
Yifan Xu (Washington University in St. Louis, USA), Anchengcheng Zhou (Washington University in St. Louis, USA), Kunal Agrawal (Washington University in St. Louis, USA), and I-Ting Angelina Lee (Washington University in St. Louis, USA)	850
Session 20: Keynote 3	
Frugal Decentralized Learning	862
Session 21: Algo-5 GPU Algorithms	
A Fine-Grained Prefetching Scheme for DGEMM Kernels on GPU with Auto-Tuning Compatibility 863 Jialin Li (Computer Network Information Center, Chinese Academy of Sciences, China; University of Chinese Academy of Sciences, China), Huang Ye (Computer Network Information Center, Chinese Academy of Sciences, China), Shaobo Tian (Computer Network Information Center, Chinese Academy of Sciences, China; University of Chinese Academy of Sciences, China), Xinyuan Li (Computer Network Information Center, Chinese Academy of Sciences; Alibaba Group, China), and Jian Zhang (Computer Network Information Center, Chinese Academy of Sciences, China)	

StencilMART: Predicting Optimization Selection for Stencil Computations Across GPUs Qingxiao Sun (Beihang University, China), Yi Liu (Beihang University, China), Hailong Yang (Beihang University, China), Zhonghui Jiang (Beihang University, China), Zhongzhi Luan (Beihang University, China), and Depei Qian (Beihang University, China)	875
Mixed Precision s-Step Conjugate Gradient with Residual Replacement on GPUs	886
Degree-Aware Kernels for Computing Jaccard Weights on GPUs	897
Fast and High-Quality Influence Maximization on Multiple GPUs	908
Session 22: Algo-6 Communications & Tensors	
Traffic-Optimal Virtual Network Function Placement and Migration in Dynamic Cloud Data Centers	919
Vincent Tran (California State University Dominguez Hills, USA), Jingsong Sun (California State University Dominguez Hills, USA), Bin Tang (California State University Dominguez Hills, USA), and Deng Pan (Florida International University, USA)	
Parallel Tensor Train Rounding using Gram SVD	930
Task-Based Acceleration of Bidirectional Recurrent Neural Networks on Multi-core	
Architectures	941
Sparsity-Aware Tensor Decomposition Sureyya Emre Kurt (University of Utah), Saurabh Raje (University of Utah), Aravind Sukumaran-Rajam (Washington State University), and P. Sadayappan (University of Utah)	952
Coloring the Vertices of 9-pt and 27-pt Stencils with Intervals	963
Session 23: SysSoft-4 Caching & Learning	
Falcon: A Timestamp-Based Protocol to Maximize the Cache Efficiency in the Distributed Shared Memory	974

HACCS: Heterogeneity-Aware Clustered Client Selection for Accelerated Federated Learning 98 Joel Wolfrath (University of Minnesota, USA), Nikhil Sreekumar (University of Minnesota, USA), Dhruv Kumar (University of Minnesota, USA), Yuanli Wang (University of Minnesota, USA), and Abhishek Chandra (University of Minnesota, USA)	5
A Swap Dominated Tensor Re-Generation Strategy for Training Deep Learning Models	6
Fast Convergence to Fairness for Reduced Long Flow Tail Latency in Datacenter Networks 100 John Snyder (Duke University, USA) and Alvin R. Lebeck (Duke University, USA)	7
Dynamic Computation Offloading for Green Things-Edge-Cloud Computing with Local Caching 1018 Xianzhong Tian (Zhejiang University of Technology, China), Huixiao Meng (Zhejiang University of Technology, China), Yanjun Li (Zhejiang University of Technology, China), Pingting Miao (Zhejiang University of Technology, China), and Pengcheng Xu (Zhejiang University of Technology, China)	
Session 24: Arch-2 Networks	
Excavating the Potential of Graph Workload on RDMA-Based Far Memory Architecture	9
SpectralFly: Ramanujan Graphs as Flexible and Efficient Interconnection Networks	.0
Booster: An Accelerator for Gradient Boosting Decision Trees Training and Inference	1
FlashWalker: An In-Storage Accelerator for Graph Random Walks	_

Memory Access Granularity Aware Lossless Compression for GPUs	174
Session 25: Multi-4 Deep Learning	
Why Globally Re-Shuffle? Revisiting Data Shuffling in Large Scale Deep Learning)85
DistrEdge: Speeding up Convolutional Neural Network Inference on Distributed Edge Devices 10 Xueyu Hou (New Jersey Institute of Technology, USA), Yongjie Guan (New Jersey Institute of Technology, USA), Tao Han (New Jersey Institute of Technology, USA), and Ning Zhang (Windsor University, Canada))97
Model-Architecture Co-design for High Performance Temporal GNN Inference on FPGA	.08
Preprocessing Pipeline Optimization for Scientific Deep Learning Workloads	.18
Session 26: Algo-7 Distributed Algorithms	
Fault-Tolerant Snapshot Objects in Message Passing Systems 11 Vijay K. Garg (University of Texas at Austin, USA), Saptaparni Kumar (Boston College, USA), Lewis Tseng (Boston College, USA), and Xiong Zheng (Google Inc, USA)	29
A Self-Stabilizing 2-Minimal Dominating set Algorithm Based on Loop Composition in Networks of Girth at Least 7	140
Syohei Maruyama (Hiroshima University, Japan), Yuichi Sudo (Hosei University, Japan), Sayaka Kamei (Hiroshima University, Japan), and Hirotsugu Kakugawa (Ryukoku University, Japan)	

Optimal Arbitrary Pattern Formation on a Grid by Asynchronous Autonomous Robots
The Universal Gossip Fighter
Session 27: Exp-3 Optimizing Applications
Modeling Matrix Engines for Portability and Performance
MLCNN: Cross-Layer Cooperative Optimization and Accelerator Architecture for Speeding Up Deep Learning Applications
Shared-Memory Parallel Algorithms for Fully Dynamic Maintenance of 2-Connected Components 1195 Chirayu Anant Haryan (IIT Tirupati, India), Ramakrishna G (IIT Tirupati, India), Kishore Kothapalli (IIIT Hyderabad, India), and Dip Sankar Banerjee (IIT Jodhpur, India)
Learning Intermediate Representations using Graph Neural Networks for NUMA and Prefetchers Optimization
HDagg: Hybrid Aggregation of Loop-Carried Dependence Iterations in Sparse Matrix Computations

Session 28: SysSoft-5 Blockchains

HRaft: Adaptive Erasure Coded Data Maintenance for Consensus in Distributed Networks 1316
Yulei Jia (Tianjin University of Technology, China; Tianjin Key
Laboratory of Intelligence Computing and Novel Software Technology,
China), Guangping Xu (Tianjin University of Technology, China; Tianjin
Key Laboratory of Intelligence Computing and Novel Software
Technology, China), Chi Wan Sung (City University of Hong Kong,
China), Salwa Mostafa (City University of Hong Kong, China), and Yulei
Wu (University of Exeter, United Kingdom)

Session 30: Arch-3 I/O Optimization

CSC: Collaborative System Configuration for I/O-Intensive Applications in Multi-Tenant Clouds	1327
Archpipe: Fast and Flexible Pipelined Erasure-Coded Archival Scheme for Heterogeneous Networks	1338
A Quantitative Study of the Spatiotemporal I/O Burstiness of HPC Application	349
DeNOVA: Deduplication Extended NOVA File System	1360

Author Index