

2018 IEEE High Performance Extreme Computing Conference (HPEC 2018)

**Waltham, Massachusetts, USA
25 – 27 September 2018**



**IEEE Catalog Number: CFP18HPE-POD
ISBN: 978-1-5386-5990-8**

**Copyright © 2018 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:	CFP18HPE-POD
ISBN (Print-On-Demand):	978-1-5386-5990-8
ISBN (Online):	978-1-5386-5989-2
ISSN:	2377-6943

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

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

PERFORMANCE OF GRAPH ANALYTICS APPLICATIONS ON MANY-CORE PROCESSORS	1
<i>Jenna Wise ; Emily Lederman ; Manoj Kumar ; Pratap Pattnaik</i>	
SCALING BETWEENNESS CENTRALITY IN DYNAMIC GRAPHS	8
<i>Alok Tripathy ; Oded Green</i>	
AMULTI-GPU PCISPH IMPLEMENTATION WITH EFFICIENT MEMORY TRANSFERS	15
<i>Kevin Verma ; Chong Peng ; Kamil Szewc ; Robert Wille</i>	
COMPUTATIONALLY EFFICIENT CP TENSOR DECOMPOSITION UPDATE FRAMEWORK FOR EMERGING COMPONENT DISCOVERY IN STREAMING DATA	22
<i>Pierre-David Letourneau ; Muthu Baskaran ; Tom Henretty ; James Ezick ; Richard Lethin</i>	
LARGE-SCALE BAYESIAN KINSHIP ANALYSIS	30
<i>Siddharth Samsi ; Bea Yu ; Darrell O. Ricke ; Philip Fremont-Smith ; Jeremy Kepner ; Albert Reuther</i>	
DAMPING EFFECT ON PAGERANK DISTRIBUTION	34
<i>Tiancheng Liu ; Yuchen Qian ; Xi Chen ; Xiaobai Sun</i>	
MEASURING THE IMPACT OF SPECTRE AND MELTDOWN	45
<i>Andrew Prout ; William Arcand ; David Bestor ; Bill Bergeron ; Chansup Byun ; Vijay Gadepally ; Michael Houle ; Matthew Hubbell ; Michael Jones ; Anna Klein ; Peter Michaleas ; Lauren Milechin ; Julie Mullen ; Antonio Rosa ; Siddharth Samsi ; Charles Yee ; Albert Reuther ; Jeremy Kepner</i>	
ALL-AT-ONCE DECOMPOSITION OF COUPLED BILLION-SCALE TENSORS IN APACHE SPARK	50
<i>Aditya Gudibanda ; Tom Henretty ; Muthu Baskaran ; James Ezick ; Richard Lethin</i>	
UNLOCKING PERFORMANCE-PROGRAMMABILITY BY PENETRATING THE INTEL FPGA OPENCL TOOLFLOW	58
<i>Ahmed Sanaullah ; Martin C. Herbordt</i>	
SOFT-CORE, MULTIPLE-LANE, FPGA-BASED ADCS FOR A LIQUID HELIUM ENVIRONMENT	66
<i>Zikun Xiang ; Tianqi Wang ; Tong Geng ; Tian Xiang ; Xi Jin ; Martin Herbordt</i>	
ACCELERATED APERTURE SYNTHESIS FROM FREE-FLYING COLLECTORS	72
<i>Zachary K. Baker ; Vinay Ramakrishnaiah ; Josh Payne ; Jon Woodring ; Nicholas Dallmann ; William Junor</i>	
A NOVEL 1D-CONVOLUTION ACCELERATOR FOR LOW-POWER REAL-TIME CNN PROCESSING ON THE EDGE	78
<i>Justin Sanchez ; Nasim Soltani ; Ramachandra Chamarthi ; Adarsh Sawant ; Hamed Tabkhi</i>	
INTERACTIVE LAUNCH OF 16,000 MICROSOFT WINDOWS INSTANCES ON A SUPERCOMPUTER	86
<i>Michael Jones ; Jeremy Kepner ; Bradley Orchard ; Albert Reuther ; William Arcand ; David Bestor ; Bill Bergeron ; Chansup Byun ; Vijay Gadepally ; Michael Houle ; Matthew Hubbell ; Anna Klein ; Lauren Milechin ; Julia Mullen ; Andrew Prout ; Antonio Rosa ; Siddharth Samsi ; Charles Yee ; Peter Michaleas</i>	
AN ACCESS-PATTERN-AWARE ON-CHIP VECTOR MEMORY SYSTEM WITH AUTOMATIC LOADING FOR SIMD ARCHITECTURES	92
<i>Tong Geng ; Erkan Diken ; Tianqi Wang ; Lech Jozwiak ; Martin Herbordt</i>	
DESIGN AND IMPLEMENTATION OF A DYNAMIC INFORMATION FLOW TRACKING ARCHITECTURE TO SECURE A RISC-V CORE FOR IOT APPLICATIONS	99
<i>Christian Palmiero ; Giuseppe Di Guglielmo ; Luciano Lavagno ; Luca P. Carloni</i>	
CHAPEL HYPERGRAPH LIBRARY (CHGL)	106
<i>Louis Jenkins ; Tanveer Bhuiyan ; Sarah Harun ; Christopher Lightsey ; David Mentgen ; Sinan Aksoy ; Timothy Stavcngr ; Marcin Zalewski ; Hugh Medal ; Cliff Joslyn</i>	
SPARSE DUAL OF THE DENSITY PEAKS ALGORITHM FOR CLUSTER ANALYSIS OF HIGH-DIMENSIONAL DATA	112
<i>Dimitris Floros ; Tiancheng Liu ; Nikos Pitsianis ; Xiaobai Sun</i>	
CHAMELEON: A GENERALIZED RECONFIGURABLE OPEN-SOURCE ARCHITECTURE FOR DEEP NEURAL NETWORK TRAINING	126
<i>Mihailo Isakov ; Alan Ehret ; Michel Kinsky</i>	
SCALABLE RMA-BASED COMMUNICATION LIBRARY FEATURING NODE-LOCAL NVMS	133
<i>Ryo Matsumiya ; Toshio Endo</i>	
DATABASE OPERATIONS IN D4M.J1	140
<i>Lauren Milechin ; Vijay Gadepally ; Jeremy Kepner</i>	
EXPLORING PARALLEL BITONIC SORT ON A MIGRATORY THREAD ARCHITECTURE	145
<i>Kaushik Velusamy ; Thomas B. Rolinger ; Janice McMahon ; Tyler A. Simon</i>	

GDP: GPU ACCELERATED DETAILED PLACEMENT	152
<i>Shounak Dhar ; David Z. Pan</i>	
AC922 DATA MOVEMENT FOR CORAL	159
<i>Steve Roberts ; Pradeep Ramanna ; John Walthour</i>	
TANGRAM: COLOCATING HPC APPLICATIONS WITH OVERSUBSCRIPTION	164
<i>Qingqing Xiong ; Emre Ates ; Martin C. Herbordt ; Ayse K. Coskun</i>	
SLIMNETS: AN EXPLORATION OF DEEP MODEL COMPRESSION AND ACCELERATION	171
<i>Ini Oguntola ; Subby Olubeko ; Christopher Sweeney</i>	
TOO MANY SECANTS: A HIERARCHICAL APPROACH TO SECANT-BASED DIMENSIONALITY REDUCTION ON LARGE DATA SETS	177
<i>Henry Kvinge ; Elin Farnell ; Michael Kirby ; Chris Peterson</i>	
CHARACTERIZING I/O OPTIMIZATION OPPORTUNITIES FOR ARRAY-CENTRIC APPLICATIONS ON HDFS	184
<i>Donghe Kang ; Vedang Patel ; Kalyan Khandrika ; Spyros Blanas ; Yang Wang ; Srinivasan Parthasarathy</i>	
UTILIZING GPU PARALLELISM TO IMPROVE FAST SPHERICAL HARMONIC TRANSFORMS	186
<i>Max Carlson ; Hari Sundar</i>	
IMPROVING PERFORMANCE AND SCALABILITY OF ALGEBRAIC MULTIGRID THROUGH A SPECIALIZED MATVEC	192
<i>Majid Rasouli ; Vidhi Zala ; Robert M. Kirby ; Hari Sundar</i>	
TOWARDS TRIANGLE COUNTING ON GPU USING STABLE RADIX BINNING	199
<i>Nishith Tirpankar ; Hari Sundar</i>	
FAULT TOLERANCE PERFORMANCE EVALUATION OF LARGE-SCALE DISTRIBUTED STORAGE SYSTEMS HDFS AND CEPH CASE STUDY	205
<i>Yehia Arafa ; Atanu Barai ; Mai Zheng ; Abdel-Hameed A. Badawy</i>	
LOGARITHMIC RADIX BINNING AND VECTORIZED TRIANGLE COUNTING	212
<i>Oded Green ; James Fox ; Alex Watkins ; Alok Tripathy ; Kasimir Gabert ; Euna Kim ; Xiaojing An ; Kumar Aatish ; David A. Bader</i>	
UPDATE ON STATIC GRAPH CHALLENGE ON GPU	219
<i>Mauro Bisson ; Massimiliano Fatica</i>	
HIGH-PERFORMANCE TRIANGLE COUNTING ON GPUS	227
<i>Yang Hu ; Hang Liu ; H. Howie Huang</i>	
FAST AND ADAPTIVE LIST INTERSECTIONS ON THE GPU	232
<i>James Fox ; Oded Green ; Kasimir Gabert ; Xiaojing An ; David A. Bader</i>	
PARALLEL COUNTING OF TRIANGLES IN LARGE GRAPHS: PRUNING AND HIERARCHICAL CLUSTERING ALGORITHMS	239
<i>Chun-Yen Kuo ; Ching Nam Hang ; Pei-Duo Yu ; Chee Wei Tan</i>	
A FAST AND EFFICIENT PARALLEL ALGORITHM FOR PRUNED LANDMARK LABELING	245
<i>Qing Dong ; Kartik Lakhota ; Hanqing Zeng ; Rajgopal Karman ; Viktor Prasanna ; Guna Seetharaman</i>	
PAGERANK ACCELERATION FOR LARGE GRAPHS WITH SCALABLE HARDWARE AND TWO-STEP SPMV	252
<i>Fazle Sadi ; Joe Sweeney ; Scott McMillan ; Tze Meng Low ; James C. Hoe ; Larry Pileggi ; Franz Franchetti</i>	
ESTIMATING EDGE-LOCAL TRIANGLE COUNT HEAVY HITTERS IN EDGE-LINEAR TIME AND ALMOST-VERTEX-LINEAR SPACE	259
<i>Benjamin W. Priest ; Roger Pearce ; Geoffrey Sanders</i>	
TRIANGLE COUNTING WITH A MULTI-CORE COMPUTER	266
<i>Evan Donato ; Ming Ouyang ; Cristian Peguero-Isalguez</i>	
FAST TRIANGLE COUNTING USING CILK	273
<i>Abdurrahman Yaşar ; Sivasankaran Rajamanickam ; Michael Wolf ; Jonathan Berry ; Ümit V. Çatalyürek</i>	
COLLABORATIVE (CPU + GPU) ALGORITHMS FOR TRIANGLE COUNTING AND TRUSS DECOMPOSITION	280
<i>Vikram S. Maitlody ; Ketan Date ; Zaid Qureshi ; Carl Pearson ; Rakesh Nagi ; Jinjun Xiong ; Wen-mei Hwu</i>	
PRELIMINARY EXPLORATION OF LARGE-SCALE TRIANGLE COUNTING ON SHARED- MEMORY MULTICORE SYSTEM	287
<i>Jiyuan Zhang ; Daniele G. Spampinato ; Scott McMillan ; Franz Franchetti</i>	
SCALABLE DISTRIBUTED MEMORY COMMUNITY DETECTION USING VITE	293
<i>Sayan Ghosh ; Mahantesh Halappanavar ; Antonino Tumeo ; Ananth Kalyanaraman ; Assefaw H. Gebremedhin</i>	
LINEAR ALGEBRAIC FORMULATION OF EDGE-CENTRIC K-TRUSS ALGORITHMS WITH ADJACENCY MATRICES	300
<i>Tze Meng Low ; Daniele G. Spampinato ; Anurag Kutuluru ; Upasana Sridhar ; Doru Thom Popovici ; Franz Franchetti ; Scott McMillan</i>	

INVESTIGATION OF SPECTRAL CLUSTERING FOR SIGNED GRAPH MATRIX REPRESENTATIONS	307
<i>Alyson Fox ; Geoffrey Sanders ; Andrew Knyazev</i>	
TRIANGLE COUNTING AND TRUSS DECOMPOSITION USING FPGA	314
<i>Sitao Huang ; Mohamed El-Hadedy ; Cong Hao ; Qin Li ; Vikram S. Mailthody ; Ketan Date ; Jinjun Xiong ; Deming Chen ; Rakesh Nagi ; Wen-mei Hwu</i>	
K-TRUSS DECOMPOSITION FOR SCALE-FREE GRAPHS AT SCALE IN DISTRIBUTED MEMORY	321
<i>Roger Pearce ; Geoffrey Sanders</i>	
FAST STOCHASTIC BLOCK PARTITION FOR STREAMING GRAPHS	327
<i>Ahsen J. Uppal ; H. Howie Huang</i>	
DISCOVERING K-TRUSSES IN LARGE-SCALE NETWORKS	333
<i>Alessio Conte ; Daniele De Sensi ; Roberto Grossi ; Andrea Marino ; Luca Versari</i>	
A DISTRIBUTED FRAMEWORK FOR LOW-LATENCY OPENVX OVER THE RDMA NOC OF A CLUSTERED MANYCORE	339
<i>Julien Hascoë ; Benoît Dupont de Dinechin ; Karol Desnos ; Jean-François Nezan</i>	
FAST AND ACCURATE OBJECT DETECTION IN HIGH RESOLUTION 4K AND 8K VIDEO USING GPUS	346
<i>Vít Růžička ; Franz Franchetti</i>	
GRAPH ALGORITHMS VIA SUITESPARSE: GRAPHBLAS: TRIANGLE COUNTING AND K-TRUSS	353
<i>Timothy A. Davis</i>	
WCET ANALYSIS OF GPU L1 DATA CACHES	359
<i>Yijie Huangfu ; Wei Zhang</i>	
REGRESSION BASED WCET ANALYSIS FOR SAMPLING BASED MOTION PLANNING	366
<i>Hao Wen ; Wei Zhang</i>	
EXPLOITING GPU WITH 3D STACKED MEMORY TO BOOST PERFORMANCE FOR DATA-INTENSIVE APPLICATIONS	372
<i>Hao Wen ; Wei Zhang</i>	
ENERGY-EFFICIENT DNN COMPUTING ON GPUS THROUGH REGISTER FILE MANAGEMENT	378
<i>Xin Wang ; Wei Zhang</i>	
SERVER-CLASS DEVICES FOR SPACE TIME ADAPTIVE PROCESSING	385
<i>Jonas Larsson</i>	
THE ROBUSTNESS OF MODERN DEEP LEARNING ARCHITECTURES AGAINST SINGLE EVENT UPSET ERRORS	392
<i>Austin P. Arechiga ; Alan J. Michaels</i>	
FUNCTIONALITY AND SECURITY CO-DESIGN ENVIRONMENT FOR EMBEDDED SYSTEMS	398
<i>Jacob Leemaster ; Michael Vai ; David Whelihan ; Haley Whitman ; Roger Khazan</i>	
GOBLINCORE-64: A RISC-V BASED ARCHITECTURE FOR DATA INTENSIVE COMPUTING	403
<i>John D. Leidel ; Xi Wang ; Yong Chen</i>	
HORNET: AN EFFICIENT DATA STRUCTURE FOR DYNAMIC SPARSE GRAPHS AND MATRICES ON GPUS	411
<i>Federico Busato ; Oded Green ; Nicola Bombieri ; David A. Bader</i>	
PERFORMANCE EFFECTS OF DYNAMIC GRAPH DATA STRUCTURES IN COMMUNITY DETECTION ALGORITHMS	418
<i>Rohit Varkey Thankachan ; Brian P. Swenson ; James P. Fairbanks</i>	
DESIGNING ALGORITHMS FOR THE EMU MIGRATING-THREADS-BASED ARCHITECTURE	425
<i>Mehmet E. Belviranli ; Seyong Lee ; Jeffrey S. Vetter</i>	
A PARALLEL IMPLEMENTATION OF FANO USING OPENMP AND MPI	432
<i>Plamen Krastev ; Albert Reuther ; Chansup Byun ; Michael Chrisp</i>	
PACKED COMPRESSED SPARSE ROW: A DYNAMIC GRAPH REPRESENTATION	437
<i>Brian Wheatman ; Helen Xu</i>	
EFFICIENT AND FLEXIBLE 2-D DATA CONTROLLER FOR SAR IMAGING SYSTEM	444
<i>Tianyun Sun ; Yizhuang Xie ; Bingyi Li ; He Chen ; Xiaoning Liu ; Liang Chen</i>	
OPTIMIZING GPU KERNELS FOR IRREGULAR BATCH WORKLOADS: A CASE STUDY FOR CHOLESKY FACTORIZATION	450
<i>Ahmad Abdelfattah ; Azzam Haidar ; Stanimire Tomov ; Jack Dongarra</i>	

INTERACTIVE SUPERCOMPUTING ON 40,000 CORES FOR MACHINE LEARNING AND DATA ANALYSIS.....	457
<i>Albert Reuther ; Jeremy Kepner ; Chansup Byun ; Siddharth Samsi ; William Arcand ; David Bestor ; Bill Bergeron ; Vijay Gadepally ; Michael Houle ; Matthew Hubbell ; Michael Jones ; Anna Klein ; Lauren Milechin ; Julia Mullen ; Andrew Prout ; Antonio Rosa ; Charles Yee ; Peter Michaleas</i>	
APPLICATION AWARE TUNING OF RECONFIGURABLE MULTI-LAYER PERCEPTRON ARCHITECTURES	463
<i>Ahmed Sanaullah ; Chen Yang ; Yuri Alexeev ; Kazutomo Yoshii ; Martin C. Herbordt</i>	
HIGH PERFORMANCE COMPUTING TECHNIQUES WITH POWER SYSTEMS SIMULATIONS.....	472
<i>Matthew Overlin ; Christopher Smith</i>	
PERFORMANCE ASSESSMENT OF HYBRID PARALLELISM FOR LARGE-SCALE RESERVOIR SIMULATION ON MULTI- AND MANY-CORE ARCHITECTURES	480
<i>Amani AlOnazi ; Marcin Rogowski ; Ahmed Al-Zawawi ; David Keyes</i>	
ACCELERATING DIJKSTRA'S ALGORITHM USING MULTIREOLUTION PRIORITY QUEUES.....	487
<i>Jordi Ros-Giralt ; Alan Commike ; Peter Cullen ; Richard Lethin</i>	
BENCHMARKING HETEROGENEOUS HPC SYSTEMS INCLUDING RECONFIGURABLE FABRICS: COMMUNITY ASPIRATIONS FOR IDEAL COMPARISONS.....	494
<i>Peter Jamieson ; Ahmed Sanaullah ; Martin Herbordt</i>	
TABULAROSA: TABULAR OPERATING SYSTEM ARCHITECTURE FOR MASSIVELY PARALLEL HETEROGENEOUS COMPUTE ENGINES	500
<i>Jeremy Kepner ; Ron Brightwell ; Alan Edelman ; Vijay Gadepally ; Hayden Jananthan ; Michael Jones ; Sam Madden ; Peter Michaleas ; Hamed Okhravi ; Kevin Pedretti ; Albert Reuther ; Thomas Sterling ; Mike Stonebraker</i>	
SPARSE DEEP NEURAL NETWORK EXACT SOLUTIONS.....	508
<i>Jeremy Kepner ; V. Gadepally ; Hayden Jananthan ; Lauren Milechin ; Sid Samsi</i>	
GRAPHCHALLENGE.ORG: RAISING THE BAR ON GRAPH ANALYTIC PERFORMANCE	516
<i>Siddharth Samsi ; Vijay Gadepally ; Michael Hurley ; Michael Jones ; Edward Kao ; Sanjeev Mohindra ; Paul Monticciolo ; Albert Reuther ; Steven Smith ; William Song ; Diane Staheli ; Jeremy Kepner</i>	
TOWARDS ENERGY-PROPORTIONAL ANOMALY DETECTION IN THE SMART GRID	523
<i>Spencer Drakontaidis ; Michael Stanchi ; Gabriel Glazer ; Jason Hussey ; Aaron St. Leger ; Suzanne J. Matthews</i>	
NEW COMPUTING FRONTIERS ENABLED VIA PHOTOVOLTAIC FIBER ENERGY GENERATION.....	530
<i>James Hanford ; Andrew Weinert</i>	
IMPLEMENTING THE JACCARD INDEX ON THE MIGRATORY MEMORY-SIDE PROCESSING EMU ARCHITECTURE.....	537
<i>Géraud P. Krawezik ; Peter M. Kogge ; Timothy J. Dysart ; Shannon K. Kuntz ; Janice O. McMahon</i>	
PERFORMANCE PORTABILITY OF A FLUIDIZED BED SOLVER.....	543
<i>V. M. Krishnarao Kotteda ; Vinod Kumar ; William Spatz ; Daniel Sunderland</i>	
A SOPC BASED FIXED POINT SYSTEM FOR SPACEBORNE SAR REAL-TIME IMAGING PROCESSING	550
<i>Bingyi Li ; Changjin Li ; Yizhuang Xie ; Liang Chen ; Hao Shi ; Yi Deng</i>	
AN ENSEMBLE CLASSIFIER BASED ON FEATURE SELECTION USING ANT COLONY OPTIMIZATION	556
<i>Jianjun Cao ; Guojun Lv ; Yuling Shang ; Nianfeng Weng ; Chen Chang ; Yi Liu</i>	
STRIPMAP SAR PULSE INTERLEAVED SCHEDULING	563
<i>John Terragnoli ; Miriam Leeser ; Paul Monticciolo</i>	
DYNAMIC DEPLOYMENT OF COMMUNICATION APPLICATIONS TO DIFFERENT HARDWARE PLATFORMS USING ONTOLOGICAL REPRESENTATIONS.....	570
<i>Yanji Chen ; Mehmet Gungor ; Shweta Singh ; Alex Tazin ; Mieczyslaw M. Kokar ; Miriam Leeser</i>	
EVALUATING AN OPENCL FPGA PLATFORM FOR HPC: A CASE STUDY WITH THE HACCMK KERNEL.....	576
<i>Zheming Jin ; Hal Finkel</i>	
SIMULATION APPROACH TO SENSOR PLACEMENT USING UNITY 3D.....	582
<i>Kimberlee Chestnut Chang ; Nicole Lane ; Andrew UhmeYer ; Michael Jones ; Matthew Hubbell ; Albert Reuther ; Robert Seater</i>	
HIGH-PERFORMANCE COMPUTING (HPC) AND MACHINE LEARNING DEMONSTRATED IN FLIGHT USING AGILE CONDOR®: UPSTREAM MACHINE LEARNING (ML) FOR ANOMALY/OBJECT DETECTION AND TARGET CLASSIFICATION	588
<i>Mark Barnell ; Courtney Raymond ; Chris Capraro ; Darrek Isereau ; Chris Cicotta ; Nathan Stokes</i>	

HYPERSCALING INTERNET GRAPH ANALYSIS WITH D4M ON THE MIT SUPERCLOUD 592

Vijay Gadepally ; Jeremy Kepner ; Lauren Milechin ; William Arcand ; David Bestor ; Bill Bergeron ; Chansup Byun ; Matthew Hubbell ; Micheal Houle ; Micheal Jones ; Peter Michaleas ; Julie Mullen ; Andrew Prout ; Antonio Rosa ; Charles Yee ; Siddharth Samsi ; Albert Reuther

Author Index