Accelerators in High Performance Computing and Computational Science

Tuesday–Wednesday, June 5–6, 2012

Topics to be covered include trends in the development of accelerator hardware and programming models and presentations on state-of-the-art applications in the following domains:

- Biosciences
- Computational Chemistry
- Finance
- Mathematical and Physical Sciences
- Multimedia

Keynote speaker: Dr. Steven Scott, CTO, TESLA-NVIDIA

Sponsored by the National Science Foundation and the CUNY Research Foundation
## Schedule

### DAY ONE – TUESDAY JUNE 5  (Center for the Arts, Recital Hall)

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<tr>
<td>8:15am</td>
<td>Registration, Continental Breakfast</td>
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<tr>
<td>9:00am</td>
<td>Welcome, Plenary Session and Keynote Addresses</td>
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<tr>
<td>9:30am</td>
<td><strong>Steven Scott</strong>, Chief Technology Officer, Tesla-NVIDIA&lt;br&gt; <em>Why the Future of HPC Will Be Green</em></td>
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<tr>
<td>10:15am</td>
<td>Break</td>
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<tr>
<td>10:30am</td>
<td><strong>Richard Lethin</strong>, Directing Engineer, Reservoir Labs&lt;br&gt; <em>Automatic Software Optimization and Generation for Programming Accelerated Computers</em></td>
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<tr>
<td>11:15am</td>
<td><strong>John Michalakes</strong>, Scientist, Scientific Computing Group, National Renewable Energy Laboratory&lt;br&gt; <em>Extreme Scale Atmospheric Modeling</em></td>
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<tr>
<td>12:00pm</td>
<td>Lunch</td>
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<tr>
<td>1:00pm</td>
<td>Session 1 - Finance</td>
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<td>1:00pm</td>
<td><strong>Moderator: Richard Holowczak, Baruch College/CUNY</strong></td>
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<tr>
<td>1:00pm</td>
<td><strong>John Melonakos</strong>, Chief Executive Officer, AccelerEyes, Inc.&lt;br&gt; <em>Productive Performance with GPUs in Finance</em></td>
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<tr>
<td>1:45pm</td>
<td><strong>Gerald Hanweck</strong>, Chief Executive Officer, Hanweck Associates, LLC&lt;br&gt; <em>Use of GPUs in Financial Engineering</em></td>
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<tr>
<td>2:30pm</td>
<td>Break</td>
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<td>2:45pm</td>
<td><strong>Stephen P. Weston</strong>, Managing Director, JP Morgan Chase&lt;br&gt; <em>Use of FPGAs to Speed the Computation of Complex Credit Derivatives</em></td>
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<tr>
<td>3:30pm</td>
<td><strong>David Taylor</strong>, Vice President of Product Architecture, Exegy, Inc.&lt;br&gt; <em>FPGAs for Market Data Processing</em></td>
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<tr>
<td>4:15pm</td>
<td>Panel on Financial Applications</td>
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<td>4:45pm</td>
<td>Conclusion</td>
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Two Sessions will be running simultaneously on Wednesday in the Recital Hall and adjacent Lecture Hall

DAY TWO – WEDNESDAY JUNE 6  (Center for the Arts, Recital Hall)

8:15am  Registration and Continental Breakfast

Session 2—Multimedia

9:00am  Multimedia Moderator: Robin Bargar, Columbia College/Chicago

9:00am  Stefan Bilbao, Senior Lecturer, University of Edinburgh

Large-scale Audio Rendering Using Graphics Processing Units

9:40am  James Perry, Edinburgh Parallel Computing Centre, University of Edinburgh

Next Generation Sound Synthesis

10:20am  Break

10:35am  Yong Cao, Assistant Professor, Computer Science Director, Animation and Gaming Research Laboratory, Virginia Polytechnic Institute and State University

Data Intensive Computing and Visualization on Many-Core Architecture

11:15am  Lynn Lewis, Principle Member Technical Staff, AMD

Multimedia Application Opportunities on an APU or Hybrid System Architecture

12:25pm  Lunch

Session 3—Biosciences

1:30pm  Biosciences Moderator: Dan McCloskey, College of Staten Island/CUNY

1:30pm  Glen Edwards, Director of Design Productivity, Convey Computer Corporation

Using Hybrid-Core Computing to Solve Bioinformatics Problems

2:15pm  Jason Bakos, Assistant Professor, Computer Science and Engineering, University of South Carolina

High-Performance Heterogeneous Computing for Genomics Applications

2:55pm  Break

3:10pm  Aurel Lazar, Professor of Electrical Engineering, Columbia University

Massively Parallel Neural Encoding and Decoding of Visual Stimuli using GPUs

3:50pm  Colin Torney, Postdoctoral Research Associate, Collective Animal Behaviour Laboratory, Department of Ecology and Evolutionary Biology, Princeton University

Structure, Function and Evolution in Social Animal Groups: Insights from GPU Accelerated Simulations of Collective Behavior

4:30pm  Panel on Bioscience Applications

5:00pm  Adjourn
## Schedule (Continued)

Two Sessions will be running simultaneously on Wednesday in the Recital Hall and adjacent Lecture Hall

### DAY TWO – WEDNESDAY JUNE 6  (Center for the Arts, Lecture)

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<td>9:00am</td>
<td>Computational Chemistry Moderator: Arben Jusufi, College of Staten Island/CUNY</td>
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| 9:00am| **James Phillips**, Senior Research Programmer, Beckman Institute, University of Illinois  
*Scalable Molecular Dynamics with NAMD* |
| 9:40am| **Martin Herbordt**, Associate Professor, Department of Electrical and Computer Engineering, Boston University  
*Molecular Dynamics on Scalable FPGA-Centric Clusters* |
| 10:30am| Break |
| 10:35am| **Ross Walker**, Assistant Professor, San Diego Supercomputer Center and Department of Chemistry and Biochemistry, University of California San Diego  
*Transforming Research in Molecular Biology through Extreme Acceleration of AMBER Molecular Dynamics Simulations: Sampling for the 99%* |
| 11:15am| **Carlos Sosa**, Applications Engineer, Cray Inc.  
*Parallel Paradigms and Performance Tools in the Biological Sciences and Computational Chemistry* |
| 11:55am| Panel Session on Chemistry Applications |
| 12:25pm| Lunch |

### Session 5—Mathematical and Physical Sciences

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<tr>
<td>1:30pm</td>
<td>Mathematical and Physical Sciences Moderator: Robert Haralick, The Graduate Center/CUNY</td>
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| 1:30pm| **Mark Arend**, Professor, Electrical Engineering, The City College/CUNY  
*FPGAs for Accelerating Coherent Wind Lidar Signal Processing* |
| 2:15am| **Cliff Woolley**, CUDA Developer Technology Engineer, Tesla-NVIDIA  
*Fundamental Performance Optimizations for GPUs* |
| 2:55pm| Break |
| 3:10pm| **Paula Whitlock**, Professor, Computer and Information Sciences  
*Using Multiple GPUs on Multiple Hosts in Simulations of Multi-Dimensional Hypersphere Systems* |
| 3:50pm| **German Kolmakov**, Assistant Professor, Physics, CityTech/CUNY  
*Non-linear Dynamics of Exciton Bose-Einstein Condensate: Numerical Simulations with GPU* |
| 4:30pm| Panel on Mathematical and Physical Science Applications |
| 5:00pm| Adjourn |
Keynote: Why the Future of HPC will be Green
Dr. Steve Scott, Chief Technology Officer, Tesla-NVIDIA

Scott is the chief technology officer (CTO) for the Tesla business unit at NVIDIA, where he is responsible for the evolution of NVIDIA’s GPU computing roadmap. Prior to joining NVIDIA, Scott served 19 years at Cray, including the last six as senior vice president and CTO, with responsibility for defining Cray's technology and system architecture roadmap. He holds 28 U.S. patents in the areas of interconnection networks, processor micro architecture, cache coherence, synchronization mechanisms and scalable parallel architectures. A noted expert in high performance computer architecture and interconnection networks, Scott was the recipient of the 2005 ACM Maurice Wilkes Award and the 2005 IEEE Seymour Cray Computer Engineering Award. He has served on numerous program committees and advisory boards.

Scott received a BS in electrical and computing engineering, an MS in computer science and a PhD in computer architecture from the University of Wisconsin, Madison, where he was a Wisconsin Alumni Research Foundation and Hertz Foundation Fellow.

Keynote: Automatic Software Optimization and Generation for Programming Accelerated Computers
Dr. Richard A. Lethin, Directing Engineer, Reservoir Labs

In 2011, the Computer Sciences and Telecommunications Board’s Committee on Sustaining Growth in Computing Performance published a study entitled “The Future of Computing Performance: Game Over or Next Level?” describing the technical challenges to sustaining performance growth rates that had previously been coming from Moore’s law shrinking of devices and increasing of clock rates. The challenges identified in the report for software include developing new techniques for high level programming of parallel computers and in particular mediating parallelism and locality. Reservoir Labs has been developing compilers in DARPA programs for high-level programming most recently in the "Ubiquitous High Performance Computing" program. This talk will present Reservoir's compiler algorithms for jointly modeling mapping trade-offs among parallelism, locality, contiguity, and SIMDization, and how they are embodied in a compiler that can parallelize and map to a number of accelerator and multi-core targets. We will discuss the research and development challenges in implementing these algorithms.

Lethin is President and Directing Engineer at Reservoir Labs, a 20-person small business with offices in Manhattan and Portland, OR. Reservoir performs contract research and development services and provides technologies for government and commercial customers in the area of high performance computing, which includes projects developing new technologies for high speed communication processing with applications in the cyber security area. Reservoir's particular expertise is centered on the software analysis and optimization tools needed to bring new forms of programming language and applications to advanced computer architectures. Government customers have included Department of Defense and Department of Energy. Commercial customers include large technology companies and financial services companies. Reservoir has won several Small Business Innovative Research contracts with successful Phase III transitions.

Current Reservoir projects include developing compiler technologies for ExaScale supercomputers with Intel Corporation in the DARPA Ubiquitous High Performance Computing program, developing systems technologies for 100 Gbps network intrusion detection, developing software for space based signal processing, developing high speed constraint solving for battle management systems, and supporting software efforts for application specific supercomputers.

Lethin teaches seminars in the Electrical Engineering Department at Yale each year as an Associate Professor Adjunct.

He received his BS in Electrical Engineering from Yale University in 1985 and MS and PhD degrees in Electrical Engineering and Computer Science from MIT in 1992 and 1997. His graduate school education was sponsored by a fellowship from the John and Fannie Hertz Foundation, an organization committed to producing leaders in technology for national security.
Extreme Scale Atmospheric Modeling

Mr. John Michalakes, Scientist, National Renewable Energy Laboratory

Weather researchers, forecasters, and climate modelers are at a turning point today with respect to extreme scale computing, since further increases in simulation capability will depend on parallelism alone. What are the opportunities for exposing and exploiting parallelism in atmospheric models? Will this help provide even weak scaling? What are the prospects for improving large memory footprint, low computational intensity applications with relatively flat performance profiles on current and next generation HPC hardware? What are the challenges and prospects for programmability?

We present status and early results of efforts to employ many- and multi-core accelerators for atmospheric simulation and discuss prospects for programmability and performance portability.

Michalakes has more than twenty years experience applying high-performance computing to atmospheric and related geophysical modeling systems, including performance-portable software design, parallel libraries, performance analysis, modeling, and optimization, and work with novel architectures such as GPUs and the Intel MIC. While at the U.S. Department of Energy's Argonne National Laboratory, Michalakes developed the first distributed memory parallel version of the Penn State/NCAR Mesoscale model and then, at the National Center for Atmospheric Research, led the software working group that developed the Weather Research and Forecast (WRF) model. Michalakes is currently at the DOE National Renewable Energy Laboratory in Golden, Colorado, applying HPC to applications related to meso-to-turbine scale flow interactions and offshore environmental conditions affecting wind farms. Michalakes was awarded a Masters of Science in Computer Science from Kent State University in 1988. He is currently working on a PhD in Computer Science at the Field Programmable Gate Array for Accelerating Coherent Wind Lidar Signal Processing University of Colorado at Boulder.

Dr. Richard D. Holowczak, Baruch College/CUNY, Moderator, Computational Finance

Holowczak is presently an Associate Professor of Computer Information Systems and is Director of the Bert W. and Sandra Wasserman Trading Floor / Subotnick Financial Services Center in the Zicklin School of Business, Baruch College, City University of New York. He holds a B.S. in Computer Science from the College of New Jersey, an MS in Computer Science from the New Jersey Institute of Technology, and MBA and PhD degrees from Rutgers University. His research focuses on financial information technologies, digital libraries, electronic commerce and networked information systems. Holowczak is also Director of the Baruch Options Data Warehouse, a 150+ terabyte repository of equity options and related financial market data.

Productive Performance with GPUs in Finance

Dr. John Melonakos, Chief Executive Officer, AccelerEyes, Inc.,

While GPUs can offer big benefit to financial computations, there is no free lunch. However, productive performance is best achieved through the use of libraries which enable programmers to maximize speed while minimizing development costs. Learn how GPU libraries provide the fastest code, least hassle, and real solutions in financial computing, offering a better alternative to compiler directives or hand-tuning custom CUDA/OpenCL code.

Melonakos is CEO of AccelerEyes. Under his leadership, the company has grown to deliver its products to thousands of customers in more than 40 countries around the globe. He has previous experience with Lockheed Martin, Hewlett-Packard, Corning Cable Systems, and General Electric. He holds a BS in Electrical Engineering from Brigham Young University and MS/PhD degrees in Electrical Engineering from the Georgia Institute of Technology.
Use of GPUs in Financial Engineering

Dr. Gerald Hanweck, Chief Executive Officer, Hanweck Associates, LLC

GPUs have found numerous applications in quantitative financial engineering. Dr. Hanweck, a pioneer in the use of GPUs in large-scale, real-time computational finance, discusses his experiences with GPUs in problems such as Monte Carlo simulation, stochastic volatility modeling, derivatives pricing and risk management. The discussion addresses what makes a quantitative finance problem amenable to GPU acceleration; design, development and implementation considerations; and a view toward the convergence of many-core technologies.

Hanweck is founder and CEO of Hanweck Associates. Previously, he served as JPMorgan's Chief Equity Derivatives Strategist from 2000 to 2003, and led the bank's U.S. Fixed-Income Derivatives Strategy team. He has taught master's-level business courses at Northwestern University's Kellogg Graduate School of Management and the Graduate School of Business at the University of Chicago, in addition to dozens of seminars on financial derivatives.

Before joining JPMorgan in 1993, he worked as a derivatives researcher at Discount Corporation of New York Futures, and as a software developer at Microsoft. Hanweck holds the following degrees: PhD, Managerial Economics and Decision Science, Kellogg Graduate School of Management, Northwestern University, AB, Mathematics, Princeton University

Use of FPGAs to Speed the Computation of Complex Credit Derivatives

Dr. Stephen P. Weston, Managing Director, JP Morgan Chase

Weston is currently head of the Applied Analytics group within the investment banking division of JP Morgan. The group is responsible for accelerating mathematical models for trading and risk management using dataflow computational techniques. Prior to joining JP Morgan, Weston spent lengthy periods at Deutsche Bank, Credit Suisse, Barclays and UBS. Prior to entering investment banking he was a university lecturer teaching mathematical economics, banking, finance and monetary theory. Stephen holds a PhD in mathematical finance from Cass Business School in London.

FPGAs for Market Data Processing

Dr. David Taylor, Vice President of Product Architecture, Exegy, Inc.

The consumption, normalization, aggregation, and distribution of real-time financial market data present a variety of network, algorithm, data structure, and computer architecture challenges. In this talk, we provide an overview of real-time financial market data and canonical architectures for its consumption and distribution to applications such as black box trading algorithms and smart order routers. We highlight several of the on-line searching and sorting problems that arise, along with some unique properties stemming from the behavior of financial markets. Given the throughput and latency requirements of electronic trading applications, serial solutions to these problems implemented in commodity processor technologies do not provide the desired level of performance. We highlight high-performance solutions to these problems that leverage heterogeneous computer architectures that include the fine-grained parallel processing capabilities of Field Programmable Gate Array (FPGA) devices.

As Vice President of Product Architecture, Taylor is leading the definition, architecture, and delivery of high-performance computing appliances for the financial services market at Exegy Inc. Previously, as Vice President of Engineering, he led a talented group of experienced software, hardware, and verification engineers, as well as financial market data business analysts and feed handler developers. The team developed novel hardware-software co-development methods to quickly deliver high-performance, hardware-accelerated compute appliances for financial trading. As an architect and engineer, he has developed numerous algorithms and architectures that provide Exegy products with industry-leading performance, functionality, scalability, and reliability. He is an inventor on 24 United States and 35 international patents and patents-pending.
Prior to joining Exegy, Taylor was a Visiting Assistant Professor in the Department of Computer Science and Engineering and was actively involved in computer communications research at the Applied Research Laboratory at Washington University in Saint Louis. He received the Doctor of Science degree in Computer Engineering in August 2004, M.S. degrees in Electrical and Computer Engineering in May 2002, and B.S. degrees with honors in Electrical and Computer Engineering in December 1998 from Washington University in Saint Louis. His research interests include heterogeneous computer architectures, parallel searching and sorting algorithms and data structures, packet classification algorithms, reconfigurable hardware systems, programmable routers, and network processors. He held a Research Internship with the network processor hardware group at the IBM Zurich Research Laboratory during the summer of 2002.

Dr. Robin Bargar, Columbia College/Chicago, Moderator, Multimedia

Bargar has a research and creative background in digital media and software development, with a focus on systems integration for interaction design and information display. In April 2011 Robin was named Dean of the School of Media Arts, and Professor in the department of Interactive Arts and Media, Columbia College Chicago, the nation's largest private college for media, communication and the arts. Previously, he was Dean of the School of Technology and Design and Professor of Entertainment Technology at the New York City College of Technology, City University of New York.

Trained as a pianist, composer and filmmaker, Robin served on the faculty of the School of Music, University of Illinois at Urbana-Champaign, and as a researcher at the National Center for Supercomputing Applications and the Beckman Institute for Advanced Science and Technology, where he led the Audio Development Group in software development and prototyping media performance in the CAVE virtual environment. Bargar also served as Director of the Integrated Systems Laboratory, an interdisciplinary environment for simulation, prototyping and visualization. Robin also designed an integrated technology program for the School of the Art Institute of Chicago, and served as Director of Hexagram, the Institute for Research and Creation in Media Arts and Technologies, Montréal. His creative work has been presented on MTV and in theatrical cinema release, and at international venues including SIGGRAPH and Ars Electronica. He holds two US Patents and received an Oscar nomination for Best Short Film (Animated).

Large-scale Audio Rendering Using GPUs
Dr. Stefan Bilbao, Senior Lecturer, University of Edinburgh

Physical modelling sound synthesis and audio effects processing is concerned with the emulation (through simulation) of acoustic entities, ranging from standard acoustic musical instruments to room acoustics to analog electronic components and hybrid electromechanical systems, and finally virtual constructions without a real world counterpart. The goals are a) greatly increasing sound quality, b) offering simplified control, and c) allowing flexible new effect/instrument design exploration while retaining sound output with an acoustic character. In many respects it is analogous to similar developments in computer graphics, also based around increasingly sophisticated simulation techniques. In some regards, however, it represents a distinct challenge: among these are the large frequency range to which the ear is sensitive, requiring very small time steps in simulation, and the strongly nonlinear nature of even simple sound producing objects. Another major challenge is that of computational cost, particularly for systems in 3D, requiring HPC solutions using numerical designs constrained by the peculiarities of human audio perception. Sound examples and video demonstrations will be presented.

Bilbao (BA, Physics, Harvard, 1992, MSc., PhD, Electrical Engineering, Stanford, 1996 and 2001 respectively) is currently a Senior Lecturer in the Acoustics group at the University of Edinburgh. He was previously a Lecturer at the Queen’s University Belfast, and a post-doctoral research associate at the Stanford Space Telecommunications and Radioscience Laboratory. His main interests are in audio sound synthesis and effects processing, and specifically simulation design for strongly nonlinear problems in acoustics, especially those which impact on audio and music technology. He is currently the group leader for a large project funded by the European Research Council, (NESS, 2012-2016) concerned with HPC audio simulation applications, and run in conjunction with the Edinburgh Parallel Computing Centre.
Physical modelling sound synthesis and audio effects processing is concerned with the emulation (through simulation) of acoustic entities, ranging from standard acoustic musical instruments to room acoustics to analog electronic components and hybrid electromechanical systems, and finally virtual constructions without a real world counterpart. The goals are a) greatly increasing sound quality, b) offering simplified control, and c) allowing flexible new effect/instrument design exploration while retaining sound output with an acoustic character. In many respects it is analogous to similar developments in computer graphics, also based around increasingly sophisticated simulation techniques. In some regards, however, it represents a distinct challenge: among these are the large frequency range to which the ear is sensitive, requiring very small time steps in simulation, and the strongly nonlinear nature of even simple sound producing objects. Another major challenge is that of computational cost, particularly for systems in 3D, requiring HPC solutions using numerical designs constrained by the peculiarities of human audio perception. Sound examples and video demonstrations will be presented.

Perry graduated from Heriot Watt University, Edinburgh, with a BEng degree in Computing and Electronics, and joined the Edinburgh Parallel Computing Centre as an applications consultant in April 2002. He works on a variety of different projects, and particular areas of interest include accelerator technologies, embedded systems and code optimisation. He currently works on the Next Generation Sound Synthesis and Application Performance Optimisation and Scalability projects, as well as contributing to the Edinburgh MSc in High Performance Computing.

Data Intensive Computing and Visualization on Many-Core Architectures

Dr. Yong Cao, Assistant Professor, Computer Science Director, Animation and Gaming Research Laboratory, Virginia Polytechnic Institute and State University

Massive datasets have made inroads into practically every field of science and engineering. Significant challenges have been recognized and focused for a variety of data intensive applications, such as scientific simulation, medical informatics, intelligence analysis, and social networks. In order to process and analyze such datasets efficiently, visualization techniques have proven to be very effective for providing high level structure and overview of the data. In this talk, I will describe the technical challenges and solutions for visualizing and analyzing massive datasets, including images, videos, volumetric data, geometry data, and graphs. The focus will be on the research of parallel algorithm design on many-core architectures, especially GPGPUs.

Cao is an Assistant Professor of Computer Science at Virginia Tech. He received his BS degree from University of Science and Technology of China in 1997, MS degree from Chinese Academy of Sciences in 2000, and PhD degree in Computer Science from University of California, Los Angeles in 2005. He has worked at a leading video game company, Electronic Arts, before joined Virginia Tech in 2007.

Cao is the Director of the Graphics and Visualization Lab at Virginia Tech, which focuses on the research of high performance visualization and simulation, parallel computing on many-core architecture, character animation, and video game based learning. He serves his research community by participating in several conference communities, including EuroGraphics, Siggraph Asia, Motion In Games, and IEEE Conference on Automatic Face and Gesture Recognition. He also serves in the editorial board of ACM Computer in Entertainment.

Cao is also a member of the Institute of Creativity, Art and Technology at Virginia Tech, whose goal is to facilitate art, creative activity, and education in cutting edge technologies and their use in contemporary arts and design.
Multimedia Application Opportunities on an APU or Hybrid System Architecture  

**Dr. Lynn Lewis**, Senior Field Applications, AMD

Lewis is a Principle Member Technical Staff at AMD working as the North Americas Field Engineering Manager. A Graduate of the United States Air Force Academy he earned undergraduate degrees in Math, Computer Science (Minot State College) and Management as well as a MBA (Georgia College) and a MS in Applied Math with graduate research at The Florida State University in Hydrodynamic Stability. As an Aeronautical Engineer and Research Scientist, he Co-founded the Computational Fluid Dynamics Section at the Air Force Armament Laboratory EAFB, Fl. There he worked as part of a small team of scientists validating perturbation and continuum approaches to simulate store separation for weapons system integration. He contributed to missile stability modeling and parallel techniques to fluid and structural simulation codes.

He worked with software and hardware engineering teams at SGI, Cray, Compaq, HP, Microsoft and AMD as a systems engineer evangelizing and demonstrating techniques for vector and scalar parallel methods as well as visualization to engineers and scientists from Volvo to Audi, Boeing to Air Bus. His work with independent software vendors influenced the first parallel commercial engineering tools from ESI Pam, Dassault Abaqus, Altair Mecalog, CD-Adapco, and Ansys. 

He earned USAF Command Pilot and Paratrooper Rating and flew as a Combat Crew Commander in both the B52G and H models for the Strategic Air Command as well as the AC-130A in Special Operations before retiring with the rank of Major from the USAFR.

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**Dr. Arben Jusufi**, College of Staten Island/CUNY, **Moderator, Computational Chemistry**

Jusufi received a PhD degree in Physics from the University of Duesseldorf, Germany. He held various postdoctoral positions, such as at the University of Pennsylvania/Temple University (Chemistry), and at Princeton University (Chemical and Biological Engineering) in which he deployed molecular simulation methods for topics related to complex fluids. Beside his academic appointments he gained experience with industrial research projects in the sector of oilfield services and consumer chemicals. Jusufi’s research involves the development and application of molecular modeling tools applied on soft nanomaterials and biological systems. He develops models for Molecular Dynamics and Monte Carlo methods in conjunction with theoretical approaches to study complex fluids on the atomistic/molecular scale. Massive parallel computations combined with efficient models and methodologies enable predictions of complex fluid behavior on the macroscopic level. Examples include: interaction of nanoparticles with lipid membranes, polymer brushes of various geometries, self-assembly phenomena of surfactants and lipid molecules, and aggregate formation of amphiphilic polymers.

The applications range from nanoscale surface patterning to the usage of nanoparticles in targeted drug delivery and biomedical cell imaging. Of particular interest in Jusufi’s research is the investigation of the interaction of nanoparticles with lipid cell membranes. Using special modeling approaches it has become computationally feasible to examine the impact of nanoparticles on cell membranes from the molecular scale up to length scales on which membrane fluctuations occur. The goal is to provide a detailed understanding of the interaction process between the nanoparticle and the lipid membrane, and to predict the impact of nanoparticles on the membrane structure, including the implications for cytotoxicity.
**Scalable Molecular Dynamics with NAMD**

**Dr. James Phillips**, Senior Research Programmer, Beckman Institute, University of Illinois,

The highly parallel molecular dynamics code NAMD was chosen in 2006 as a target application for the NSF petascale supercomputer now know as Blue Waters. NAMD was also one of the first codes to run on a GPU cluster when G80 and CUDA were introduced in 2007. This talk will present the past, present, and future of accelerators in NAMD, including the challenges of integrating CUDA with the Charm++ message-driven parallel runtime.

Phillips is a Senior Research Programmer in the Theoretical and Computational Biophysics Group at the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. He has a Ph. in Physics from the University of Illinois and a BS in Physics and Mathematics from Marquette University. Since 1999, James has been the lead developer of the highly scalable parallel molecular dynamics program NAMD, for which he received a Gordon Bell Award in 2002. His research interests include improving the performance and accuracy of biomolecular simulations through parallelization, optimization, hardware acceleration, better algorithms, and new methods.

**Molecular Dynamics on Scalable FPGA-Centric Clusters**

**Dr. Martin Herbordt**, Associate Professor, Department of Electrical and Computer Engineering, Boston University

The current effervescence in Computer Architecture is leading to serious (re)examination of FPGAs as augmentations to CPU-based processors. Examples range from the Intel Atom processor, to the Convey Hybrid Supercomputer, to multiple lines of IBM servers. In this talk we first review the state of the art of FPGA-based HPC and design patterns we have found to be effective. The bulk of the talk then consists of highlights from our research in developing FPGA-accelerated Molecular Dynamics. This has two parts. The first is a review of our now mature work with the range limited force, including a discussion of advances in the force computation pipeline and novel methods for particle-pair filtering. In the second part we introduce a new project which explores how core FPGA attributes—configurability, low power, and immense communication support—make FPGA-centric systems attractive for large-scale MD.

Herbordt received his BA in Physics from the University of Pennsylvania and his PhD in Computer Science from the University of Massachusetts. He is currently a Professor in the Department of Electrical and Computer Engineering at Boston University where he directs the Computer Architecture and Automated Design Lab. His overall research interests are in Computer Architecture and High Performance Computing. Since joining Boston University in 2001, Herbordt has focused on high performance computing using accelerators such as FPGAs and GPUs, particularly in their application to computational problems in biology (Bioinformatics and Computational Biochemistry), and in creating development tools for those accelerators. This work is being supported by grants from the NIH and the NSF and has also been supported by IBM, Xilinx, SGI, XtremeData, Gidel, and Altera. Other recent work involves methods for energy- and thermal-aware software (supported by the MGHPCCC). Martin has received an NSF Career award, an IBM faculty award, and multiple conference best paper awards. He is the co-General Chair of the 2013 edition of IPDPS in Boston.

**Transforming research in molecular biology through extreme acceleration of AMBER molecular dynamics simulations: Sampling for the 99%**

**Dr. Ross C. Walker**, Assistant Professor, San Diego Supercomputer Center and Department of Chemistry and Biochemistry, University of California San Diego

This talk will cover recent developments in the acceleration of Molecular Dynamics Simulations using NVIDIA Graphics Processing units with the AMBER software package. In particular it will focus on recent algorithmic improvements aimed at accelerating the rate at which phase space is sampled. A recent success has been the reproduction and extension of key results from the DE Shaw 1 millisecond Anton MD simulation of BPTI (Science, Vol. 330 no. 6002 pp. 341-346) with just 2.5 days of dihedral boosted AMD sampling on a single GPU workstation. These results show that with careful
algorithm design it is possible to obtain sampling of rare biologically relevant events that occur on the millisecond timescale using just a single $500$ GTX580 Graphics Card and a desktop workstation.

Walker is an Assistant Research Professor at the San Diego Supercomputer Center, an Adjunct Assistant Professor in the Department of Chemistry and Biochemistry at the University of California, San Diego and an NVIDIA Fellow. He runs the Walker Molecular Dynamics Lab in San Diego where he leads a team that develops advanced techniques for Molecular Dynamics Simulations supporting work aimed at improved drug and biocatalyst design. His work includes improved Quantum Mechanical, Molecular Mechanical models, development of new force fields for simulation of lipid membranes, simulations of cellulase enzymes for improved cellululosic bioethanol production and the development of a GPU accelerated version of the AMBER Molecular Dynamics engine PMEMD.

Parallel Paradigms and Performance Tools in Computational Chemistry on Cray Supercomputers

Dr. Carlos Sosa, Applications Engineer, Cray Inc.

The accurate computation of chemical and biochemical properties, whether derived from molecular or electronic structure, will continue to demand as much computational power as can reasonably be provided. Computational scientists in these fields have been early adopters of recent CPU-attached acceleration technologies (both GPUs and FPGAs), and Cray has a long history of delivering enhanced performance through acceleration starting with its early vector computers, today with its GPU-accelerated XK6 systems, and before the end of the decade with exascale capable systems.

In this presentation, we review some of the tools and parallel programming methods currently in use in the chemical and biological sciences in a Cray context. In particular, we emphasize the new OpenACC compiler-directives-based approach for creating mixed CPU-GPU accelerated programs from a single, portable, standard Fortran source. We provide an update on the accelerator-based parallelization of the explicit polarization (X-Pol) theory and the variational many-body (VMB) expansion method using the OpenACC directives. VMB/X-Pol is a fragment-based electronic structural method for macromolecular simulations, introduced as a quantum mechanical force field for biomolecular systems to treat both polarization and charge transfer explicitly.

Sosa is an Applications Engineer in the Performance Group at Cray, Inc. Prior to joining Cray, Inc, he was a Senior Technical Staff Member in the High-Performance Computing Solutions Development Group at IBM, where he was the team lead of the Chemistry and Life Sciences group in the Blue Gene development group since 2006. For the past 20 years, his work focused on scientific applications with emphasis in Life Sciences and parallel programming. He received a PhD degree in physical chemistry from Wayne State University working under the direction of Prof. Schlegel, one of the main developers of the Gaussian program. He completed his post-doctoral work at the Pacific Northwest National Laboratory. His research expertise falls broadly in the areas of molecular simulations, bioinformatics, and parallel computing. His research in parallel computing focuses on scaling applications in these areas to emerging hardware architectures such as the Cray flagships XK6 and XE6 supercomputers. He has led numerous strategic projects at IBM and Cray Research on addressing challenging scientific applications with cutting-edge high-performance computing technologies. He is the author of four IBM books as well as numerous publications in international journals and conferences. Currently, he holds an editorial board member of Current Drug Discovery Technologies, and he was also a visiting member of IBM Academy of Technology.

He is also an Adjunct Professor at the Biomedical Informatics and Computational Biology, University of Minnesota Rochester. Prior to joining IBM Carlos worked at Cray Research in the Chemistry Group. There he helped parallelize the Gaussian94 program to the Cray T3E and later Carlos and co-workers used OpenMP to parallelize Gaussian on shared-memory machines.
Dr. Dan McCloskey, College of Staten Island, CUNY, Moderator, Biosciences

McCloskey is an Assistant Professor of Psychology at the College of Staten Island/CUNY where he is Co-Coordinator of the Master’s program in Developmental Neuroscience. He holds doctoral appointments at the CUNY Graduate Center in Neuroscience and Neuropsychology. McCloskey received his PhD in Biological Psychology from The State University of New York at Stony Brook in 2003. McCloskey uses a combination of computationally intensive approaches to study animal behavior, quantitative neuroanatomy, and single-cell and network-level electrophysiology. He has co-authored dozens of peer-reviewed journal articles using these techniques to address issues in epilepsy and autism.

High-Performance Heterogeneous Computing for Genomics Applications

Dr. Jason Bakos, Associate Professor, Computer Science and Engineering, University of South Carolina

Since the first petascale system was built nearly five years ago, trends have shown that next-generation high-performance computer systems will likely be composed of heterogeneous nodes, where traditional general-purpose processors are tightly integrated with special-purpose coprocessors. At this time, there are several existing and emerging coprocessor technologies, each with its own strengths and programming models. At the same time, new scientific applications, including many that are not based on traditional numerical linear algebra methods, have recently emerged and are quickly achieving high importance—particularly those in computational biology and data mining. The development of new methodologies for efficiency mapping these applications to heterogeneous computer systems is a crucial challenge on the road to exascale computing.

In this talk we summarize our experiences in the Heterogeneous and Reconfigurable Computing Laboratory at the University of South Carolina. We will highlight several applications we have targeted, including whole phylogeny reconstruction, pyrosequencing noise removal, and association rule mining. We will discuss the methods we used to map these applications to various heterogeneous platforms and the platforms themselves, including the Convey HC-1, GiDEL PROCSTAR III, and Advantech TI C66x DSP platform. We will also discuss our work in building development tools for adapting arbitrary applications to heterogeneous platforms.

Bakos is an associate professor of computer science and engineering at the University of South Carolina. He received a BS in computer science from Youngstown State University in 1999 and a PhD in computer science from the University of Pittsburgh in 2005. Bakos’s research focuses on adapting scientific applications to non-traditional high-performance computer systems. Bakos was among the first researchers to accelerate computational biology applications using FPGA-based coprocessors, and this goal continues to be a main emphasis of his work. Bakos’s group is currently targeting applications in computational phylogenetics, metagenomic sequencing, association rule mining, and sparse linear algebra. His group works closely with FPGA-based computer manufacturers Convey Computer Corporation, GiDEL, and Annapolis Micro Systems, as well as GPU and DSP manufacturers NVIDIA, Texas Instruments, and Advantech. Bakos’s group is a member of the NSF CHREC Novo-G Forum, a consortium of 11 academic teams from different universities working to develop programming models and standards for high-performance reconfigurable computing. Bakos holds two patents, has published over 30 refereed publications in computer architecture and high performance computing, was a winner of the ACM/DAC student design contest in 2002 and 2004, and received the US National Science Foundation CAREER award in 2009. He is currently serving as associate editor for ACM Transactions on Reconfigurable Technology and Systems, as permanent program committee member and publication chair for the IEEE Symposium on Field Programmable Custom Computing Machines, and is a member of the IEEE, Computer Society, and ACM.
Massively Parallel Neural Encoding and Decoding of Visual Stimuli Using GPUs
Dr. Aurel A. Lazar, Professor of Electrical Engineering, Columbia University

The massively parallel nature of Video Time Encoding Machines (TEMs) calls for scalable, massively parallel decoders that are implemented with neural components. The current generation of decoding algorithms is based on computing the pseudo-inverse of a matrix and does not satisfy these requirements. Here we consider Video TEMs with an architecture built using Gabor receptive fields and a population of Integrate-and-Fire neurons. We show how to build a scalable architecture for Video Time Decoding Machines using recurrent neural networks. Furthermore, we extend our architecture to handle the reconstruction of visual stimuli encoded with massively parallel Video TEMs having neurons with random thresholds. Finally, we discuss in detail our algorithms and demonstrate their scalability and performance on a large scale GPU cluster.

Lazar is a Professor of Electrical Engineering at Columbia University. In the mid 80s and 90s (http://www.ee.columbia.edu/~aurel/networking.html), he pioneered the fields of networking games and open programmable networks. His current research interests (http://www.bionet.ee.columbia.edu/) are at the intersection of computational, theoretical and systems neuroscience. In silico, his focus is on neural encoding in and systems identification of sensory systems, and, spike processing and neural computation in the cortex. In this work, he investigates rigorous methods of encoding information in the time domain, functional identification of spiking neural circuits as well as massively parallel neural computation algorithms in the spike domain. In vivo, his focus is on the olfactory system of the Drosophila. His current work primarily addresses the nature of odor signal processing in the antennal lobe of the fruit fly.

Using Hybrid-Core Computing to Solve Bioinformatics Problems
Dr. Glen Edwards, Director of Design Productivity Technology, Convey Computer Corporation

Convey Hybrid-Core computers accelerate applications by applying hardware acceleration to compute or memory intensive algorithms. This hardware acceleration is delivered in the form of “personalities” that can be reloaded dynamically on Convey’s FPGA-based coprocessor. Convey has developed a suite of personalities that improve the performance of commonly used bioinformatics applications and algorithms, such as Smith Waterman, Blast, BWA and the Convey Graph Constructor (used for Velvet). These tools and others have been developed using the Personality Development Kit, which is also available to end users for developing custom personalities for Convey Systems.

This talk will provide an overview of the Convey architecture and the Personality Development Kit, as well as a description of how the Personality Development Kit can be used to exploit this architecture to solve problems in bioinformatics.

Edwards is the Director of Design Productivity Technology at Convey Computer. He is responsible for the Convey Personality Development Kit, which enables end users to accelerate applications on Convey hybrid-core platforms. His current focus is on decreasing the design time and complexity required to implement custom designs, through innovations in development tools, and through collaborations with customers and third-party tool vendors. Prior to Convey, he was a hardware design engineer at Hewlett Packard, where he designed system boards and FPGAs for HP’s high-end servers.

Structure, function and evolution in social animal groups: Insights from GPU accelerated simulations of collective behavior
Dr. Colin Torney, Postdoctoral Research Associate, Collective Animal Behaviour Laboratory, Department of Ecology and Evolutionary Biology, Princeton University

A significant problem in a wide range of biological disciplines is understanding how functionality at a collective scale emerges from the actions and interactions among the individual components. Animal groups such as bird flocks, fish schools and insect swarms have evolved a multitude of complex and effective collective behaviors. Studying these groups represents an unrivaled opportunity to link the behavior of individuals with the functioning and efficiency of group-level properties. In this
talk, I will present some recent work on collective decision making, group foraging and information processing in social
groups. I will demonstrate how we can use simulations to better understand empirical results, and also investigate evolution-
ary questions which are simply not possible to address through an experimental program alone. Novel GPU-based
technologies mean we are now able to rapidly simulate interacting groups consisting of thousands of individuals, evolve in
silico complex collective behaviors, and incorporate ever more realistic environments into our studies.

Torney is a postdoctoral researcher in the Collective Animal Behavior Lab at Princeton University, headed by Professor Iain
Couzin. He received a PhD degree in Applied and Computational Mathematics from University College, Dublin, and holds
Masters degrees in Computational Science and Integrated Engineering. His research is focused on developing a theoretical
description of collective animal behaviour through mathematical and computational modeling. This work incorporates the
evolution of social behaviour and the influence of stochastic environmental effects, and aims to improve our understanding of
the ecology and functioning of animal populations.

Dr. Robert Haralick, The Graduate Center/CUNY, Moderator, Mathematical and Physical Sciences

Haralick is Distinguished Professor, Computer Science, The Graduate Center, City University of New
York. Before coming to The Graduate Center, he held the prestigious Boeing Egvedt Professorship in
Electrical Engineering at the University of Washington and was vice president of research at Machine
Vision International. A fellow of the Institute for Electrical and Electronic Engineers and the
International Association for Pattern Recognition (where he also held the office of president), he has
served on the editorial boards of journals such as IEEE Pattern Analysis and Machine Intelligence,
Haralick has authored more than 550 books, chapters, journal articles, and conference papers, among
them the seminal two-volume Computer and Robot Vision. He has contributed to image texture analy-
sis, facet modeling for image analysis, shape analysis using mathematical morphology, and in general to computer image
processing, computer vision, computer document analysis, and artificial intelligence. His most recent work is in high-dimen-
sional space clustering and pattern recognition techniques applied to combinatorial problems in free group theory.

Field Programmable Gate Array for Accelerating Coherent Wind Lidar Signal Processing
Dr. Mark Arend, Professor, Electrical Engineering, The City College/CUNY

Recent increases in Field Programmable Gate Array (FPGA) performance and size offer new hard-
ware acceleration opportunities for real time environmental remote sensing technologies such as
ground based Doppler ranging for weather and climate monitoring. One example is an optical
cohere nce detection wind lidar system that has been developed at the City College of New York.
His presentation will discuss how the FPGA is used to accelerate signal processing of return signals
that backscatter off the atmosphere in this fiber-based eye safe lidar system.

Arend is a NOAA CREST Research Professor and a City University of New York Research Associate.
He has over 30 years of research experience in industry, academia and government. Arend received a PhD, MPhil and MS in
Applied Physics from Columbia University and a BS in Physics from University of Washington. He worked six years in industry
both in the high power microwave amplifier industry with Teledyne Microwave Corporation and in research and
development for long haul undersea fiber optics telecommunications with Tyco Submarine Systems (formally Bell
Laboratories). His research in fiber optics systems at the Naval Research Laboratory, Princeton University and at City College
of New York involved many areas of systems, sub systems and optical components research. This research has led to develop-
ments in high band width (100’s of Tbit/sec) transmission and large capacity (Petascale) computing and has involved
many experimental as well as numerical modeling efforts relating to nonlinear dynamical systems. His current research inter-
ests in the Optical Remote Sensing Laboratory at the City College of New York involve the development of novel sensing
instrumentation (e.g. lidar, radar, sodar) and networks that are used together with satellite observations and complex numer-
ical models of coupled environmental systems with an emphasis on Urban Coastal Meteorology. The research is focused on
developing new information resources to be used by regional stakeholders in urban environments with practical applications in the North East metropolitan region and with general extensions that can hopefully be applied to help our society better understand and prepare for urbanization and global change.

Fundamental Performance Optimizations for GPUs
Mr. Cliff Woolley, Senior Developer Technology Engineer, Tesla-NVIDIA

This session will present the fundamental performance-optimization concepts and illustrate their practical application in the context of programming for Fermi and Kepler GPUs. The goal of this session is to demystify performance optimization by transforming it into an analysis-driven process. There are three fundamental limiters to kernel performance: instruction throughput, memory throughput, and latency. In this session we will describe how to use profiling tools to assess the significance of each limiter, what optimizations to apply for each limiter, and how to determine when hardware limits are reached.

Woolley is a developer technology engineer with NVIDIA Corporation. He received his Master's degree in Computer Science from the University of Virginia in 2003. He was among the earliest academic researchers to investigate the use of graphics processors for general-purpose computation, having applied these early GPGPU ideas both to non-traditional graphics rendering techniques as well as to non-graphical applications such as a multigrid solver for PDEs.

Using Multiple GPUs on Multiple Hosts in Simulations of Multi-Dimensional Hypersphere Systems
Dr. Paula Whitlock, Professor, Computer and Information Sciences, Brooklyn College/CUNY

A Metropolis Monte Carlo code that studies the properties of a binary mixture of four dimensional hyperspheres is modified to run on a network of hosts with two Nvidia GPU attached to each host. Significant decreases in execution time are achieved as a result of the code modifications which include the use of OpenMPI and the CUDA extensions to the C computer language.

Whitlock is Professor of Computer and Information Sciences at Brooklyn College, the City University of New York. She received her BS from the State University of New York at Stony Brook and her PhD from Wayne State University. For many years, she was a research scientist at the Courant Institute of Mathematical Sciences, New York University. Her research interests include the development of Monte Carlo methods and their application to the study of condensed matter systems. Dr. Whitlock is also interested in the development of applications in parallel and distributed computing.

Non-linear Dynamics of Exciton Bose-Einstein Condensate: Numerical Simulations with Graphics Processing Units
Dr. German V. Kolmakov, Assistant Professor, Physics, CityTech/CUNY

Kolmakov studies the nonlinear dynamics of a Bose-Einstein condensate (BEC) of dipole excitons trapped in an external confining potential in coupled quantum wells. Through numerical integration of the generalized Gross-Potaevskii equation for the BEC, we characterized the process of the condensate build-up and decay. In the simulations, we account for the finite lifetime of the dipole excitons and generation of the excitons due to continuous laser pumping. It is demonstrated that, if the system is driven at sufficiently high frequencies, a new, turbulent state is formed in the BEC. We took advantage of the GPU programming to speedup the simulations and obtain the results for a macroscopically large system within a practically reasonable amount of time. We also discuss the application of this numerical technique to other quantum systems, in particular, long lifetime polaritons.
Kolmakov is Assistant Professor at the New York City College of Technology/CUNY. After his education at the Moscow Institute of Physics and Technology (MIPT) and L.D. Landau Institute for Theoretical Physics, he worked as a scientific researcher at the Institute of Solid State Physics, Chernogolovka, and an Assistant Professor at MIPT and then, as a Research Assistant Professor at the University of Pittsburgh. He is a Fellow of the Institute of Physics, and he was a Leverhulme Fellow, 2003-2004, and EPSRC Visiting Research Fellow, 2005-2008, at the Department of Physics of Lancaster University. His research interests include low temperature and solid state physics, turbulence, nonlinear dynamics and, most recently, application of high-performance computing in hydrodynamics and condensed matter physics.
About the College of Staten Island of The City University of New York

The College of Staten Island is a four-year, senior college of The City University of New York that offers exceptional opportunities to all of its students. Programs in the liberal arts and sciences and professional studies lead to bachelor and associate’s degrees. The master’s degree is awarded in 16 professional and liberal arts and sciences fields of study. The College participates in doctoral programs of The City University Graduate School and University Center in Biology, Chemistry, Computer Science, Nursing, Physical Therapy, and Physics.

A broad general education is assured through requirements that allow students to explore a range of fields of knowledge and acquire educational breadth in mathematics, the sciences, social sciences, arts, and humanities. Requirements for the bachelor’s degree provide a disciplined and cumulative program of study in a major field of inquiry. Enrollment in baccalaureate programs requires freshman admission standards consonant with those of CUNY senior colleges. Enrollment in associate’s degree programs is open to all students with a high school diploma or the equivalent.

The College of Staten Island’s park-like 204-acre campus includes state-of-the-art classrooms, laboratories, studios, and offices in two academic quadrangles. Noteworthy facilities include the Astrophysical Observatory, the Biological Sciences and Chemical Sciences Building, the CSI Center for the Arts, and the CSI Library. In addition, CSI offers a spectacular Sports and Recreation Center with pool, fitness annex, fitness center, basketball courts, squash courts, and tennis courts.
Scientific literacy is a *sine qua non* of an educated citizenry. Yet today, with students’ participation and proficiency in science, technology, engineering, and mathematics fields on the decline, our country’s preeminence in science education and innovation is in question.

The Chancellor of The City University of New York designated the years 2005 to 2015 the “Decade of Science” and pledged to renew the University’s commitment to creating a healthy pipeline to science, technology, engineering, and mathematics (STEM) by advancing science at the highest levels, training students to teach in these areas, and encouraging young people, particularly women and minorities, to study in these disciplines.

As part of this commitment, the College of Staten Island and The City University of New York are working to strengthen their curricula in computational science and to provide the cyberinfrastructure required to support the activities of a major research and education institution. In mid-2007, the High-Performance Computing Center initiative was launched with the mission to support:

- The “Decade of Science” Initiative
- The University’s research and educational activities by making state-of-the-art HPC resources and expert technical assistance available to faculty and students
- With CUNY faculty and researchers, the development of proposals for external funding
- National and New York initiatives in economic development
- National and New York initiatives to promote the sharing of HPC resources and technical knowledge
- Educational outreach programs designed to encourage intermediary and high school students to pursue higher education and careers in science and technology

With funding from the National Science Foundation and local City and State of New York officials, The City University of New York now has the most capable academic High-Performance Computing Center in the New York Metropolitan Area. The City University of New York is working to expand these resources and to continue to share these capabilities with other academic institutions, particularly those in the New York Metropolitan Area. But, there is more. The College of Staten Island and The City University of New York have committed to build an “Interdisciplinary High-Performance Computing Research Center” that will serve as a nucleus for researchers and educators in the computational sciences and will also house the High-Performance Computing resources. The Interdisciplinary High-Performance Computing Research Center, to be located on the campus of the College of Staten Island, is currently in architectural design. Above is an artist’s rendering of the proposed LEED Platinum-certified 170,000-square-foot building that will house the Center.
UPCOMING WORKSHOPS

Dates to Be Announced.

For additional information on The City University of New York’s High-Performance Computing Center and upcoming workshops, visit www.csi.cuny.edu/cunyhpc/.

DIRECTIONS TO THE COLLEGE OF STATEN ISLAND, CUNY
The workshop will be held in the Center for the Arts, Building 1P on the College of Staten Island Campus.

BY AUTOMOBILE

Parking is available on the campus. All visitors should obtain a temporary parking pass from the security booth at the campus entrance and display it in their front windshield. Parking is available in Parking Lots 6 and 7.

From the Verrazano-Narrows Bridge (Toll on Staten Island). Traveling westbound on the Staten Island Expressway (Interstate 278) from the Verrazano-Narrows Bridge, take Victory Boulevard Exit #10. At Victory Boulevard, turn left and continue under the Expressway and turn left into the campus at the first traffic light.

From the Goethals Bridge (Toll on Staten Island). Eastbound on the Staten Island Expressway (Interstate 278), take the Victory Boulevard Exit # 8 and turn left onto Victory Boulevard, and turn right at the first traffic light into the campus.

From the Outerbridge Crossing (Toll on Staten Island). Take the West Shore Expressway to the Staten Island Expressway (Interstate 278) east toward the Verrazano-Narrows Bridge. On the Staten Island Expressway (Interstate 278) east take the Victory Boulevard Exit 8 and turn left onto Victory Boulevard and turn right at the first traffic light to campus.

From the Bayonne Bridge (Toll on Staten Island). Take the West Shore Expressway (Route 440) south Exit 11 toward Victory Boulevard and turn right at the first traffic light to enter the campus. Approximate five miles from the bridge.

BY STATEN ISLAND FERRY

The Staten Island Ferry operates between Whitehall Street in lower Manhattan and St. George on Staten Island. The five-mile, 25-minute ride also provides a majestic view of New York Harbor and a no-hassle, even romantic, boat ride, for free. The Ferry departs every 20 minutes during rush hours and every 30 minutes at other times during the day. The Ferry schedule can be found at www.siferry.com/SIFerry_Schedules.aspx.

From St. George on Staten Island, you can take the CSI Ferry Shuttle, the S62 Travis bus, or a taxi to the College of Staten Island.

CSI Ferry Shuttle. After arriving at the St. George Ferry Terminal in Staten Island, follow signs for the CSI free ferry shuttle bus to the lower public parking areas at the base of the Grand Staircase. The bus trip from the St. George Ferry Terminal to the campus takes about 30 minutes. Riders are advised to check the shuttle schedule at www.csi.cuny.edu/ferryshuttle/pdf/ShuttleTimeTable.pdf.

S62 Travis Bus. The S62 bus, destined for Travis, departs from the upper level of the St. George Ferry Terminal. The bus schedule generally conforms to the Ferry schedule. The bus stops at the entrance to the campus of the College of Staten Island.

Taxis. There is a taxi stand at the base of the Grand Staircase of the St. George Terminal.
**BY EXPRESS BUS**

**Manhattan**
Staten Island Express Bus X-10—frequent daily schedule from 57th Street and Third Avenue to Victory Boulevard and the return route; stops at the main campus entrance-North Entrance Gate. The fare is $5.50 for one-way, and exact change in coins or a MetroCard is required. [www.mta.info/nyct/bus/schedule/xpress/x10cur.pdf](http://www.mta.info/nyct/bus/schedule/xpress/x10cur.pdf)

**Brooklyn**
S53—The route is from the Bay Ridge section of Brooklyn, accessible to the R subway at 95th street and Fourth Avenue, via Clove Road on Staten Island to Port Richmond. A free transfer is available for the S62 at Clove Road and Victory Boulevard. The trip from Bay Ridge to Clove Road and Victory Boulevard is approximately half an hour. The fare is $2.50 for one-way, and exact change in coins or a MetroCard is required. [www.mta.info/nyct/bus/schedule/staten/s053cur.pdf](http://www.mta.info/nyct/bus/schedule/staten/s053cur.pdf)

S93—The MTA will run a limited stop service between the 86th Street R Train Station and Fourth Avenue in Bay Ridge, Brooklyn and the CSI main entrance. Approximate travel time is 35 minutes. It will serve direct connections to Brooklyn busroutes B8, B16, B37, B63, B64, and B70, and Subway route R. There are 12 scheduled trips from Bay Ridge, Brooklyn each weekday morning and nine from the College each weekday afternoon. The runs to CSI in the morning departing Brooklyn are at 6:40am, 6:55am, 7:10am, 7:25am, 7:40am, 7:55am, 8:10am, 8:25am, 8:40am, 8:55am, 9:10am, and 9:22am. There are nine runs in the afternoon leaving CSI at 3:00pm, 4:10pm, 4:55pm, 5:10pm, 5:40pm, 6:10pm, 6:40pm, 7:10pm, and 7:40pm. The fare is $2.50 for one-way, and exact change in coins or a MetroCard is required. [www.mta.info/nyct/bus/schedule/staten/s093cur.pdf](http://www.mta.info/nyct/bus/schedule/staten/s093cur.pdf)

**TAXI SERVICES ON STATEN ISLAND**

Apple Car Service 718.442.1000
Area’s Two 718.967.3232/800.550.1188
Sam’s Car 718.442.0500
Staten Island Car Service 718.761.5100
Village Car Service 718.698.6900