Master of Science in Computer Science with Specialization in High Performance Computing and Simulations (MSCS-HPCS)

http://www.cs.usc.edu/academics/masters/mshighperform.htm

Aiichiro Nakano
Email: anakano@usc.edu
High Performance Computing

- **USC HPCC (Center for High Performance Computing & Communication):** 13,440 CPU-core GPU-accelerated 0.62 petaflop/s cluster

- **USC ISI (Information Sciences Institute):** 1,098-qubit D-Wave quantum computer

![93 petaflop/s TaihuLight](Image)

![USC-HPCC](Image)

![GPGPU](Image)

![Quantum computer](Image)
Computational Sciences at USC

The Nobel Prize in Chemistry 2013

Collaboratory for Advanced Computing & Simulations

- 5.0 trillion-atom molecular dynamics
- 39.8 trillion electronic degrees-of-freedom quantum molecular dynamics
- 300+ million core-hrs/yr of computing on a 786,432-core, 8.6 petaflop/s Blue Gene/Q

cacs.usc.edu
High-End Computing at CACS

- Won two DOE supercomputing awards to develop & deploy metascalable ("design once, scale on future platforms") simulation algorithms (2017-2020)

- NAQMD & RMD simulations on full 800K cores

Principal Investigator: Aichiro Nakano, University of Southern California
Co-Investigator: Priya Vashishta, University of Southern California

786,432-core IBM Blue Gene/Q

Early Science Projects for Aurora
Supercomputer Announced
Metascalable layered materials genome
Investigator: Aichiro Nakano, University of Southern California

180+ petaflop/s
Intel Xeon Phi KNH (2019)

- One of 10 exclusive users of the next-generation DOE supercomputer
MSCS-HPCS Objectives

- Train a new generation of MS students in Computer Science to solve challenging scientific & engineering problems using high-end parallel computers, high-speed networks & advanced scientific visualization

- Support a unique dual-degree opportunity, in which students can obtain a Ph.D. in the physical sciences/engineering & an MS in Computer Science, to attract high-quality students
MSCS-HPCS Requirement

A total of **32 units**

1. **Required Core Courses in Computer Science: 3 courses**
   - CSCI570 (analysis of algorithms)
   - 2 from: CS561 (AI), CS 571 (Web), CS585 (database)

2. **Required Core Course for MSCS-HPCS:**
   - CSCI596 (scientific computing & visualization)

3. **Elective Courses for MSCS-HPCS: Total of 3 courses from both tracks (a) & (b)**
   a. **Computer Science Track**
   - CSCI653 (high performance computing & simulations),
   - CS520 (animation), CS551 (communication),
   - CS558L (network), CS580 (graphics), CS583 (comp geometry),
   - CS595 (advanced compiler), EE653 (multithreaded arch), EE657 (parallel processing),
   - EE659 (network), Math501 (numerical analysis)

   b. **Computational Science/Engineering Application Track**
   - AME535 (comp fluid dynamics), CE529 (finite element), CHE502 (numerical transport),
   - EE553 (comp optimization), MAS575 (atomistic simulation), PTE582 (fluid flow),
   - Phys516 (computational physics), ...
CACS HPCS Courses

• **CS596: Scientific Computing & Visualization**
  Hands-on training on particle/field simulations, parallel computing, & scientific visualization (MPI, OpenMP, CUDA, OpenGL)

• **CS653: High Performance Computing & Simulations**
  Deterministic/stochastic simulations, scalable parallel/Grid computing, & scientific data visualization/mining in virtual environment

• **Phys516: Methods of Computational Physics**
  Numerical methods in the context of physics simulations

http://cacs.usc.edu/teaching.php
HPC Tutorials & Office Hours

Series of tutorials + office hours (T, 2:30-5 pm, LVL 3M) at the USC Center for High Performance Computing (HPC):

• CUDA computing on GPU
• Parallel MATLAB
• ...

http://hpcc.usc.edu/support/hpcc-computing-workshops
http://hpcc.usc.edu/officehours

Students registered by the end of this week will get an HPC account
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