

Computational Science & Engineering Research Institute Proposal

December 5, 2007

CSE [Computational Science and Engineering] focuses on the development of problem-solving methodologies and robust tools for the solution of scientific and engineering problems. We believe that CSE will play an important if not dominating role for the future of the scientific discovery process and engineering design.

SIAM Working Group on CSE Education, 2001 [1]

1 Introduction

This proposal to establish the Computational Science and Engineering Research Institute (CSERI) at MTU is the next step in the development of CS&E as a research program and academic discipline at MTU. The CS&E Ph.D. program was established in 1994 under the Ph.D. in Engineering umbrella. Until recently it served a dual role as a home for Ph.D. students concentrating on research in computer science and as a home for interdisciplinary computational science and engineering Ph.D. students. Since the establishment of the Ph.D. in Computer Science in the spring of 2001, the CS&E Ph.D. program now houses only interdisciplinary students.

The CS&E Ph.D. program was reviewed by the Graduate School in Fall, 2001. David Walker¹ concluded that “the goals of the [Ph.D.] program are clearly articulated, and the program is distinct from traditional departmental PhD programs.” Both external reviewers recommended that the CS&E program should grow. Chief among the suggestions for achieving growth was the establishment of a Computational Science and Engineering Institute. The first recommendation made by Lori Freitag² was to, “*Create a CS&E institute at MTU*”.

¹Professor of High Performance Computing, Department of Computer Science, Cardiff University, Wales.

²Research Scientist, Mathematics and Computer Science Division, Argonne National Laboratory.

David Walker also suggested that one way to develop CS&E at MTU was to “...base the program within a research institute for CSE”.

CS&E faculty join with the reviewers in supporting the establishment of the CS&E Institute. This new institute will expand the mission of the CS&E Ph.D. program to foster a much broader CS&E presence at MTU. Included in this mission are new incentives for faculty participation, wider recognition of CS&E as a research discipline aligned with MTU’s strategic plan, and greater activity among students and faculty in computationally intensive research projects.

2 Statement of Purpose

The Computational Science and Engineering Research Institute will foster education and research in the development and application of computational technologies to problems of national interest in the sciences and engineering. The Institute will provide students and faculty with the structure and resources needed to accomplish these goals.

3 Mission Statement

The goals of the CS&E Institute are:

Continue the development of the CS&E academic program as a successful, non-departmental, interdisciplinary degree. The CSERI will be unique at MTU as the only one that administers a graduate degree program. The CS&E Ph.D. degree is the only degree at MTU that may be granted by any science and engineering department. Over 50 U.S. universities have CS&E institutes and/or degree programs. (See Appendix A.) One of the current priorities of the CS&E faculty is to overhaul the current CS&E Ph.D. program and to consider other ways to strengthen the academic presence of CS&E at MTU. Success in this area will be judged by the number of graduates and by their placement after graduation. Also important are the levels of faculty involvement in the creation and delivery of the CS&E curriculum and the types of projects they undertake with CS&E students.

Establish CS&E as a recognized academic discipline at MTU. This goal is distinct from that of having a successful academic program in CS&E, though the academic program contributes to this goal. It is also necessary to establish that the development and deployment of new computational techniques is as significant a contribution to science and engineering as are new discoveries made in the laboratory. It is important to establish that CS&E research is based on identifiable principles that are distinct from those in the traditional fields of science and engineering. The attached document [1] elaborates some of these principles. Success

here will be determined by whether the CS&E program is acknowledged by the University community as an identifiable academic discipline.

Establish CS&E as a recognized research area at MTU that addresses scientific and engineering problems of national interest. All major federal laboratories have computational science and engineering divisions. (See Appendix B.) This goal will be achieved by increasing the visibility of the academic and research programs. More CS&E students, more participating faculty, larger-scale research projects, a greater physical presence on campus, and the acknowledgment of this growth by the University administration will serve to establish CS&E as a major research program at MTU. CS&E research must be publicly recognized as one of the University's leading contributors to the advancement of science and engineering.

Establish the CSERI as the focal point for externally funded, computational research projects at MTU. The qualitative or quantitative nature of the computational work done in CS&E projects often exceeds that which can be underwritten by a single grant or by a single academic unit. No one school or department at MTU has enough computational scientists to warrant a stand-alone center. To support CS&E research at MTU it is necessary to pool the needs of these researchers. The CSERI will focus funding efforts for projects that have such needs. The support of computationally intensive research projects requires coordinated efforts in many areas. These areas include computational resources (hardware and software), systems administration services, network infrastructure, staff support, and administrative support.

Attract CS&E faculty to MTU. During the past several years the CS&E program has been instrumental in attracting new faculty to MTU. Dr. Adrian Sandu joined the Department of Computer Science in 1998 as an Assistant Professor. Dr. Sandu recently received an NSF CAREER award to study air quality models. He holds a Ph.D in Applied Mathematical and Computational Sciences from the University of Iowa. In 1999 Dr. Phillip Merkey joined the Department of Computer Science as a Research Assistant Professor. Dr. Merkey is fully funded by the Earth and Space Sciences Program at the Goddard Space Flight Center and he is responsible for bringing to MTU the 64-node Beowulf cluster from the Goddard Space Flight Center. Dr. Franz Tanner joined the Department of Mathematical Sciences in 1999 as an Associate Professor. His research area is computational fluid dynamics. He and his students are regular users of CS&E computational facilities.

The increased visibility and opportunity afforded to new faculty by the CSERI will continue to attract faculty in this critically important research discipline.

Establish the CSERI as the primary provider of high performance computational resources at MTU. For the past four years the CS&E program has provided all researchers at MTU, and many off-campus users, free access to the largest and fastest computers on campus. With continued funding efforts and support from the University, these resources will

grow to match the needs of researchers in the CSERI. Success here will be achieved if the CSERI is always able to provide researchers with the computational resources they need. (For currently available computational facilities, see <http://www.cse.mtu.edu/computing.html>.)

The CS&E program at MTU has a broad mission including graduate education, interdisciplinary research, and computational resources. This program has established an active record in these areas over the past several years. It is appropriate to create the CSERI at this time because this program is currently engaged in all the activities characteristic of an MTU institute and it will continue in this mission for the foreseeable future.

4 Proposed Activities

The activities of the CSERI fall into three categories. The first consists of near term “must do” activities required by the CS&E Action Plan of January 28, 2002. The second group consists of longer-term programmatic activities that are now under discussion and will be accomplished within one year. The third group of activities is the core of the ongoing activities of the CSERI.

4.1 Near Term Priorities

Immediately following approval, we will develop a Charter for the new Institute. The Charter will describe the mission, proposed activities, and governance structure, and include a strategic plan. The plan will specify explicit goals regarding the deployment and integration of advanced computational techniques into research projects at MTU, the number of graduate students supported, research funds generated, faculty release time paid from Institute projects, and indirect costs recovered. The Charter will be completed within the Institute’s first year.

The viability of the CS&E Ph.D. program is critically dependent on the successful completion of the students currently in the program and on the continuing admission of new students. Details of current student status is summarized in the Action Plan. The following three activities are of the highest priority to the new Institute’s support of the CS&E degree program.

Ensure current CS&E Ph.D. students complete their degrees in a timely manner.

All four current students have been making excellent progress. Advisors of CS&E Ph.D. students must give these students high priority and they must be responsive to the unique needs these students are likely to have during the coming two to three years. All current students are expected to complete their degrees on schedule. Every effort will be made to provide the support needed to these students in the event exceptional circumstances arise.

Recruit new students. At least four new students should be recruited each year to ensure that one or two graduate each year. This recruiting rate must be reached by the fall of 2003. This expectation is consistent with the timing of the appearance of the recently placed ads in *Peterson's Guide*. Additional, more highly focused, recruiting efforts should also be made between now and then.

Obtain funding for the direct support of CS&E students. Funding from the Department of Education's Graduate Assistance in Areas of National Need (GAANN) program has been obtained in the past by the departments of Geological Sciences, Mining, and Environmental Engineering. This program is an excellent match with CS&E but it is not accepting proposals in 2002. This program does expect to accept proposals in 2003. Application will be made to the Department of Energy's High-Performance Fellowship Program next year if an eligible CS&E student is available. Other funding for students will be pursued as available.

4.2 Long Term Activities

The following activities, suggested at various points during the review process, are now being undertaken by the CS&E faculty.

Increase external funding. The CSERI must increase the level of outside funding of CS&E research at MTU. The current national agenda is strongly supportive of CS&E research [2]. With suitable incentives, faculty participation will grow and external funding growth will follow. A continuing task of the CS&E faculty will be to identify projects to pursue and to organize joint funding efforts.

Develop a core curriculum for the Ph.D. and develop an MS program. Problematic among these goals are the establishment of a CS&E core curriculum and MS program. The CS&E faculty has begun discussions about these tasks. The proposal for the changes to the CS&E degree program will be presented at the beginning of this academic year.

Establish a physical "home" for the program and its students. Also problematic is finding space for CS&E students and research labs. CILIT Phase I plans include a modest amount of CS&E laboratory space but no space earmarked for students. Advice on how to meet these needs will be solicited from the Graduate School, Research Office, and other units on campus. Resource requirements are discussed further in Section 8.

Finally, the CS&E faculty will consider how the administration of the program should be changed to encompass the broader range of activities that will now be undertaken in this program. An outline of the administration of the CSERI is given in Section 7.

4.3 Ongoing Activities

The following activities are the primary, ongoing goals to which the CSERI is committed.

- Offer the nondepartmental CS&E Ph.D.
- Recruit high quality graduate students.
- Support CS&E graduate students in the form of startup fellowships, “bridging” support, and travel.
- Coordinate large scale, interdisciplinary, interdepartmental funding efforts centered on computational science.
- Provide incentives to students, faculty, and departments to participate in CS&E activities.
- Provide computational resources to support CS&E students and faculty.
- Maintain CS&E as the center of high performance at MTU.
- Provide a CS&E seminar series that includes outside speakers.
- Offer computational expertise for researchers undertaking computer-intensive projects.
- Manage CS&E resources for the benefit of its students, faculty, and the MTU community.

5 Faculty

Membership in the CSERI is based on activity during the past one to two years, including committee membership, student advising and recruiting, general participation, teaching, proposal-writing, and research contributions. The current list of CS&E faculty is maintained by the CS&E Director on the CS&E web page.

Current CS&E Faculty

College of Sciences and Arts

Steve Carr

Phillip Merkey

Computer Science

Computer Science

Nilufer Onder	Computer Science
Soner Onder	Computer Science
Linda Ott	Computer Science
Adrian Sandu	Computer Science
Steven Seidel	Computer Science
Phil Sweany (adjunct, Texas Instruments)	Computer Science
Kathy Feigl	Mathematical Sciences
Mark Gockenbach	Mathematical Sciences
Franz Tanner	Mathematical Sciences
John Jaszczak	Physics
Ulrich Hansmann	Physics

College of Engineering

David Miller (adjunct, Rose-Hulman IT)	Chemical Engineering
Warren Perger	Electrical and Computer Engineering
Greg Bluth	Geological Engineering and Sciences
Judith Budd	Geological Engineering and Sciences
Alex Mayer	Geological Engineering and Sciences
Donna Michalek	Mechanical Engineering - Engineering Mechanics

The signature page of this proposal is endorsed by the chairs and deans of the current CS&E faculty but this does not preclude faculty in other academic units from joining the CSERI in the future.

6 Justification

The mission of the CSERI is aligned with several goals of the University's Strategic Plan:

Goal 1: Learning^a

- 1.3 Offer programs in new and emerging areas, particularly interdisciplinary areas (*e.g.* ... information technology).

Strategies: ○ Structure a system in which cooperation between units is rewarded.

Goal 2: Scholarship^b

- 2.1 Increase the number of interdisciplinary efforts in a few, well-focused platforms that will lead to world-class recognition.

Strategies: ○ Form cross-departmental, cross-college/schools faculty teams in our areas of focus.
○ Ensure that interdisciplinary work is properly recognized and rewarded.

- 2.2 Increase the number of faculty actively engaged in research and graduate education;

Strategies: ○ Reward scholarship and graduate education;
○ Choose new faculty with strong research and graduate education interests.

- 2.3 Increase the percentage and number of graduate students who are supported externally;

Strategies: ○ Reward faculty who support graduate students;
○ Give the recruitment of graduate students highest priority;
○ Provide competitive compensation and benefit packages to attract and retain quality graduate students.

^a<http://www.mtu.edu/stratplan/learning.html>

^b<http://www.mtu.edu/stratplan/scholarship.html>

The CSERI will also undertake to meet some of the challenges currently facing MTU, as identified in the Strategic Plan:

II. OUR CURRENT CONTEXT^a Michigan Tech faces several challenges:

- There is inadequate physical infrastructure and facilities for some units.
- The University is not well-positioned in many areas of national research priorities and in some emerging fields of study required for this century's workforce.

^a<http://www.mtu.edu/stratplan/context.html>

The CSERI is the appropriate next step to take in the development of computationally-based research at MTU. The program reviewers were very specific in recommending that the scope of the existing CS&E program must grow. The faculty of the CS&E program understands its mission and enthusiastically supports it. The CSERI will provide opportunities and resources that no single academic unit can provide.

7 Governance

CS&E faculty membership is described in Section 5.

7.1 Director

The Director is nominated by the CS&E faculty. The nomination is sent to the Vice President of Research for approval. The Director is responsible for academic program(s) including admissions, recruiting, curriculum, and student advising. The Director is also responsible for the research program, administration, support, and personnel. The Director will serve as the primary contact for the CS&E and will represent the institute to the MTU community as well as the national and international computational science community.

7.2 Faculty Committee

A standing Faculty Committee of four CS&E faculty is responsible for providing continuity and for advising the Director. The Faculty Committee reviews matters of policy, particularly with regard to admissions standards and the CS&E degree program standards. The Committee makes recommendations for the acceptance of applicants to the CS&E program as well as recommendations to determine whether a project and associated grant should be identified as a CS&E project. Finally, the Committee is responsible for reviewing the budget for the Institute. The Director is an *ex officio* fifth member of the Faculty Committee. Members of the Faculty Committee serve three-year staggered terms. The current membership of the existing CS&E Faculty Committee is:

CS&E Faculty Comm.	Academic Unit	Term Expires
Warren Perger	Electrical & Computer Eng.	summer, 2003
Judith Budd	Geological Eng. & Sci.	summer, 2004
Franz Tanner	Mathematical Sci.	summer, 2004
Steven Seidel	Computer Science	summer, 2005

The CS&E faculty nominates and approves a new member of the Faculty Committee when their term expires or when a position becomes vacant.

Other committees may be formed at the will of the CS&E faculty.

7.3 Program Review

The CSERI will be reviewed every 5 years. The next review will be done early in 2007. The review of CS&E degree program(s) and the CSERI review will be done together.

8 Resource Requirements

It is very important to the identity and viability of the institute to have an established home. Laboratory space, student offices, and a machine room is needed to support the activities of the institute. CILIT Phase I includes some machine room space and some laboratory space, but this new space will not be available until 2005. CS&E computational equipment currently consumes about half of the floor space occupied by computational equipment in the Center for Experimental Computation and more CS&E equipment is going to be acquired in the near future. There is currently no laboratory space available for CS&E faculty or students and CILIT Phase I does not include space for CS&E students. Discussions must be undertaken immediately to develop a plan to provide the CSERI with a permanent home.

9 Funding

The proposed overhead return structure has been designed to provide the funds required to make the CS&E a viable program. These funds will cover operating expenses (administrative staff, hardware and software maintenance, licenses, etc.), direct and indirect student support, and support for professional activities (travel, workshops, invited speakers, etc). The overhead structure is also designed to provide an incentive to PI's and their department chairs. Faculty are encouraged to participate in the institute and to contribute to multi-disciplinary teams that can compete for larger projects that are now being funded by the national agencies.

We propose the following procedure to determine whether or not a grant or project is appropriate for the CSERI. The PI for the grant will write a memo to the CSERI Director. The CS&E committee will forward its recommendation along with the memo to the V.P. of Research. The V.P. of Research will make the final determination. This memo should address

the fact that either the characteristics or the objectives of the project should be aligned with the mission of the Institute. Such characteristics or objectives include: the multi-disciplinary or cross-college composition of the research team, the requirement computational resources that are otherwise beyond their means, the application of advanced computational techniques, the development of computational tools and techniques, the application of novel computational methods to new areas of science or engineering research and education.

Annual CS&E research expenditures were over \$200,000 last year and will be greater this year. Expenditures of \$500,000 to \$750,000 can be realistically expected within three years. The current 6% overhead return to CS&E has gone almost exclusively to advertising the Ph.D. program. A greater return rate is needed to support the growth of the program and to encourage faculty participation. We propose the following overhead return structure:

Unit	Percentage return
MTU	40.0
Principal Investigator	9.0
Department Chair	15.0
College	7.3
CS&E	28.7

It is too early to project a detailed budget. A budget outline is given below that shows the proportions in which CS&E funding will be allocated to various activities. Note that most funding for CS&E computational equipment is expected to come from external funding, as it has in the past. However, some of the CS&E budget is allocated for miscellaneous computing needs that are not covered by major external funding.

- 45% Graduate Program
 - direct support (*e.g.*, fellowships)
 - bridge support, travel, seminars, recruiting, matching funds
- 20% Computational Support
 - hardware, software, licenses, maintenance
 - network charges, Internet 2
- 35% Personnel
 - Director
 - Systems administrators
 - Staff

10 Summary

Computational science and engineering is playing an increasingly important role in education, scientific discovery and engineering design. CS&E should play an increasingly important role at MTU. The recent external review of the CS&E Ph.D. program contained recommendations for the establishment of a CSERI as a way to develop CS&E at MTU. The CSERI will foster education and research, will provide a home for students and faculty, will provide MTU with high performance computational resources, will attract CS&E faculty to MTU, and will increase MTU's competitiveness in obtaining funding for the large projects which require a CS&E component that are now being funded at the national level.

The establishment of a CSERI is aligned with the University's Strategic Plan. An effective Institute will further MTU's development as a research institution. The CSERI will provide a formal structure for the de facto CS&E group that has formed as a result of the recent introduction of the CS Ph.D. and the recent faculty hires that have CS&E interests. The organization of the Institute and the overhead structure is consistent with other successful institutes at MTU.

References

- [1] Graduate education for computational science and engineering. *SIAM Working Group on CSE Education*, December 2001. <http://www.siam.org/cse/report.htm>.
- [2] Peter Harsha. Congressional support for research appears strong, but work continues. *Computing Research News*, 14(1):pp. 1,6, January 2002.

Appendix A: CS&E Divisions at U.S. and European Laboratories

Argonne:	Center for Computational Science and Technology http://www-fp.mcs.anl.gov/ccst/
Goddard:	NASA Center for Computational Science http://sdc.d.gsf.nasa.gov/NCCS/
Langley:	Institute for Computer Applications in Science and Engineering http://www.icase.edu/
Los Alamos:	Computer and Computational Sciences http://www.ccs.lanl.gov/
NASA Ames:	Computational Sciences Division http://ic.arc.nasa.gov/
Oak Ridge:	Center for Computational Sciences http://www.ccs.ornl.gov/
Sandia:	Computation, Computers, and Mathematics Center http://www.cs.sandia.gov/
ETH Zurich, Switzerland	Institute of Computational Science http://www.icos.ethz.ch/
ETH Zurich, Switzerland	Computational Science and Engineering http://www.cse.ethz.ch/
KTH Stockholm	Master of Science in Scientific Computing http://www.nada.kth.se/kurser/master/index-eng.html

Appendix B: CS&E Centers and Institutes at U.S. Universities

(Source: University of Illinois, Computational Science and Engineering³)

Arizona State Univ.	Systems Science and Engineering Research Center http://www.eas.asu.edu/~sserc
Boston College	Scientific Computation http://physics.bc.edu/MS <i>minor in Scientific Computation</i>
Boston University	Center for Computational Science http://ccs.bu.edu
CalTech	Applied and Computational Mathematics http://www.acm.caltech.edu Center for Advanced Computing Research http://www.cacr.caltech.edu
Catholic Univ. of America	Institute for Astrophysics and Computational Sciences http://iacs.cua.edu <i>formed within the physics department</i>
Clark University	Computational Science http://science.clarku.edu/compu_sci.html <i>undergraduate program—a concentration in computation</i>
College of William and Mary	Computational Science Cluster http://www.info@CompSci.wm.edu/home.html <i>similar to CS&E at MTU</i>
Cornell	Center for Applied Mathematics http://www.cam.cornell.edu <i>quite Math centric</i>
Florida State	Computational Science and Information Technology http://www.csit.fsu.edu
Illinois State Univ.	Computational Science Laboratory http://www.phy.ilstu.edu/UCSL/UCSL.html <i>undergraduate program from physics and chemistry</i>
Indiana	Scientific Computing http://www.indiana.edu/scicomp/minor.html <i>Ph.D. Minor: interdepartmental program</i>
MichiganTech	Computational Science and Engineering http://www.cse.mtu.edu
Mississippi State Univ.	Computational Engineering http://www.erc.msstate.edu/cme/compu_eng <i>offers MS and PhD</i>

³<http://www.cse.uiuc.edu/>

New York University Scientific Computing
http://cs.nyu.edu/csweb/Research/Groups/scientific_computing.html
 Courant Institute of Mathematical Sciences
<http://www.cims.nyu.edu>

North Carolina State Univ. Center for Research in Scientific Computation
<http://www.ncsu.edu/crsc>
 Numerical Analysis
<http://www.ncsu.edu/ncsu/math/NA/NAHomePage.html>
similar to MTU's structure

Oregon State Univ. Computational Physics
<http://nacphy.physics.orst.edu>
Physics centric program
 Northwest Alliance for Computational Science and Engineering
<http://www.nacse.org>
Oregon State partnering with other organizations

Pennsylvania State Univ. Institute for High Performance Computing Applications
<http://www.psu.edu/dept/ihpca/>
offer graduate minors in HPC
 Numerical Analysis and Scientific Computation
http://www.math.psu.edu/shen_j/na-psu/na-home.html
math centric

Princeton Program in Applied and Computational Mathematics
<http://www.math.princeton.edu/PACM>
offers graduate program and undergrad certificates

Purdue Computational Science and Engineering
<http://www.cse.purdue.edu/cse-frame.html>
interdisciplinary program, offers M.S. and Ph.D. specializations

Rensselaer Polytechnic Inst. Computational Science and Engineering
<http://www.cs.rpi.edu/flaherje/index2.html>
 Scientific Computation Research Center
<http://www.scorec.rpi.edu>

Rice Computational Science and Engineering
http://www.citi.rice.edu/research/cse_program.shtml
 Computational and Applied Mathematics
<http://www.caam.rice.edu>
 Houston Area Computational Science Consortium
<http://www.crpc.rice.edu/CRPC/HACSC>
 Center for Computational Geophysics
<http://terra.rice.edu/department/ccg>

San Diego State	Computational Science Program http://www.sci.sdsu.edu/compsci Education Center on Computational Science and Engineering http://www.edcenter.sdsu.edu
Shodor Education Found.	Computational Science Institute http://www.shodor.org/scsi
Stanford	Scientific Computing and Computational Mathematics http://www-sccm.stanford.edu/nflash/nf-frameset.html Mathematical and Computational Science http://www.stanford.edu/group/mathcompsci
SUNY at Brockport	Computational Science http://www.cps.brockport.edu
SUNY at Buffalo	
SUNY at Buffalo	Center for Computational Research http://www.ccr.buffalo.edu
Syracuse	Computational Science http://www.npac.syr.edu/projects/cpsedu/curriculum Northeast Parallel Architectures Center http://www.npac.syr.edu
Texas A&M	Computational Science and Engineering http://www.isc.tamu.edu/isc/CSE Institute for Scientific Computation http://www.isc.tamu.edu/isc/main.html
Univ. of Alaska	Scientific Computing Option http://www.math.uaa.alaska.edu/mathsci/cs/bssc.html <i>undergrad computing option</i>
Univ. of Arizona	Computational Science and Engineering http://grad.admin.arizona.edu/catalog/departments/cse.html <i>Ph.D. minor</i>
UC Berkeley	Computational Engineering Science Program http://langmuir.EECS.Berkeley.EDU/johnv/CES/
UC Davis	Center for Computational Science and Engineering http://yclept.ucdavis.edu/CSE Department of Applied Science http://www.das.ucdavis.edu
UC Los Angeles	Computational and Applied Mathematics http://www.math.ucla.edu/applied

UC San Diego	Scientific Computation http://www.scicomp.ucsd.edu San Diego Supercomputer Center http://www.sdsc.edu National Partnership for Advanced Computational Infrastructure http://www.npaci.edu
UC Santa Barbara	Computational Science and Engineering http://www.engineering.ucsb.edu/cse Institute for Computational Earth System Science http://www.crseo.ucsb.edu
Univ. of Colorado, Boulder	Applied Mathematics http://amath.colorado.edu Numerical Computation http://www.cs.colorado.edu/95-96/faculty/numerical.html
Univ. of Colorado at Denver	Center for Computational Mathematics http://www-math.cudenver.edu/ccm
Univ. of Delaware	Scientific Computation http://www.cis.udel.edu/research/scientific.php Numerical Analysis and Scientific Computing http://www.math.udel.edu/monk/NA.html
Univ. of Houston	Computational Science Initiative http://www.math.uh.edu/csiuh.html Houston Area Computational Science Consortium http://www.crpc.rice.edu/CRPC/HACSC
Univ. of Illinois at Chicago	Computational Science and Applied Mathematics http://www.math.uic.edu/hanson/AppliedMath.html
Univ. of Illinois	Computational Science and Engineering http://www.cse.uiuc.edu <i>grad option: each dept sets in own requirements</i> National Center for Supercomputing Applications http://www.ncsa.uiuc.edu National Computational Science Alliance http://www.ncsa.uiuc.edu/About/Alliance
Univ. of Iowa	Applied Mathematical and Computational Sciences http://www.math.uiowa.edu/amcs
Univ. of Kentucky	Center for Computational Sciences http://www.ccs.uky.edu <i>Institute: focus on research</i> Numerical Analysis and Scientific Computing http://www.ms.uky.edu/rcli/NASC.html

Univ. of Maryland	Applied Mathematics and Scientific Computation http://www.amsc.umd.edu Institute for Advanced Computer Studies http://www.umiacs.umd.edu
Univ. of Michigan	Laboratory for Scientific Computation http://www.engin.umich.edu/labs/lasc/lasc.html Center for Parallel Computing http://www.engin.umich.edu/center/cpc
Univ. of Minnesota	Laboratory for Computational Science and Engineering http://www.lcse.umn.edu Institute for Mathematics and its Applications http://www.ima.umn.edu
Univ. of New Mexico	Scientific and Engineering Computation http://www.arc.unm.edu/Educate/SEC/SEC.html Albuquerque High Performance Computing Center http://www.arc.unm.edu
Univ. of Oregon	Computational Science Institute http://www.csi.uoregon.edu <i>Institute: focus on research</i>
Univ. of Tennessee	Computational Science Program http://netlib2.cs.utk.edu/utk/cs_dept Joint Institute for Computational Science http://www-jics.cs.utk.edu <i>co-located with ORNL</i>
Univ. of Texas at Austin	Computational and Applied Mathematics http://www.ticam.utexas.edu/cam <i>offer M.S. and Ph.D. degrees</i>
Univ. of Utah	Computational Engineering and Science http://www.ces.utah.edu <i>elective courses include science and engineering</i>
Univ. of Washington	Applied and Computational Mathematical Sciences http://www.ms.washington.edu/acms
Univ. of Wyoming	Institute for Scientific Computation http://isc.uwyo.edu <i>interdisciplinary program based in the math dept</i>
Virginia Tech	Lab for Advanced Scientific Computing and Appls http://vtopus.cs.vt.edu/lasca/ High Performance Computing and Communications http://www.aoe.vt.edu/hpccp/hpccp.html <i>heavy influence from NASA Langley</i>