# COMPUTATIONAL SCIENCE, ENGINEERING & MATHEMATICS:

# PATH TO DEGREE

*Fall 2024*


Todd Arbogast

*Chair of the Graduate Studies Committee*

*Center for Subsurface Modeling of the*
*Oden Institute for Computational Engineering and Sciences*
*and*
*Department of Mathematics*

*The University of Texas at Austin*

## Computational Science & Engineering

Computational science and engineering (CSE) is an exciting and emerging field of rigorous interdisciplinary scientific study. The use of mathematical modeling is growing rapidly and used

- to understand the dynamics of complex systems, and
- to make predictions about their behavior.

Traditionally, the pillars of science are theory and experiment. Today, CSE is becoming the third pillar, providing a link between the first two pillars through high performance computing and simulation.

## A Brief History of CSE at UT-Austin

**1973** Professor J. Tinsley Oden founds the Texas Institute for Computational Mechanics (TICOM) as a research group.

**1993** TICOM becomes the Texas Institute for Computational and Applied Mathematics (TICAM) through gifts from the Peter O'Donnell, Jr., foundation (which total over $143 millon to date).

- A graduate program is established in Computational and Applied Mathematics (CAM).

**2001** Texas Advanced Computing Center (TACC) is established.

**2003** TICAM becomes the Institute for Computational Engineering and Sciences (ICES) with a greatly expanded scope and expertise.

**2010** CAM is renamed the Computational Science, Engineering, and Mathematics (CSEM) graduate program.

**2019** ICES becomes the Oden Institute for Computational Engineering and Sciences.

The Oden Institute, CSEM, and TACC are intertwined

**2023** Commemorating 50 years of leadership

# The CSEM Degree Program


CSEM Students, Fall 2018

## Overview of CSEM

CSEM is interdisciplinary. To analyze, model, and simulate a system, researchers must develop a broad and deep understanding of the three CSEM Concentration Areas:

Area A. Applicable mathematics;

Area B. Numerical analysis and scientific computation;

Area C. Applications and mathematical modeling of a natural, engineered, social, or other system.

A disciplinary view misses the surprisingly complex ways these interact.

Each student must demonstrate breadth and proficiency in each of the three concentration areas. Research for CSEM dissertations must demonstrate an interdisciplinary theme and draw on knowledge from the three CSEM concentration areas.

## CSEM Concentration Areas

*Area A, Applicable Mathematics.* Area A encompasses the mathematical theory and foundations underlying the scientific models and computational science addressed in the overall research effort.

Functional analysis, partial differential equations, differential geometry, probability, data science, optimization, and approximation theory.

*Area B, Numerical Analysis and Scientific Computation.* Area B, encompasses all areas of algorithms and computational simulation, as well as their development, verification, and analysis.

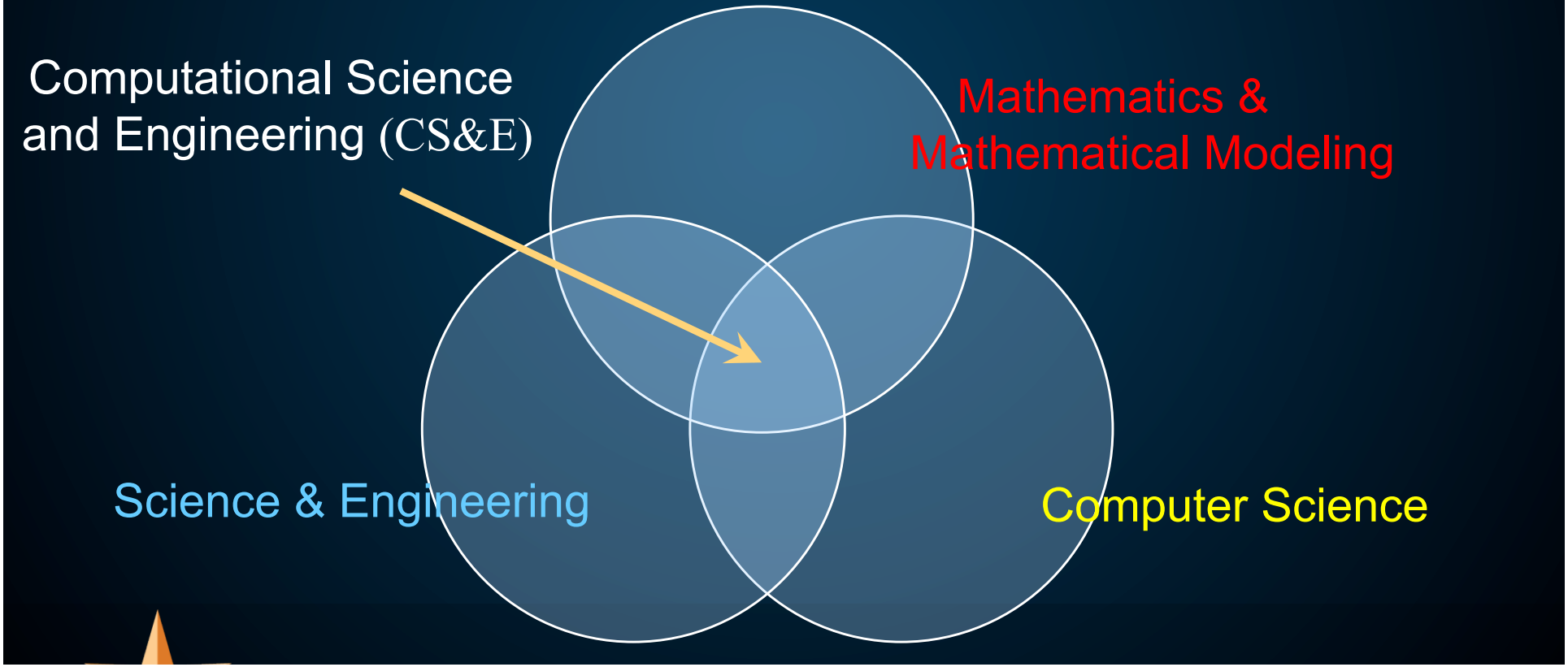
Numerical stability and approximation, scientific programming, visualization, parallel computation, software design, and high performance computing.

*Area C, Mathematical Modeling and Applications.* Area C encompasses the scientific principles of the natural, engineered, social, or other system that motivates the research and aims to foster some scientific or societal goal through computational modeling and simulation.

Students develop a concentration of course work in a well-defined discipline of science, engineering, medicine, economics, or the social sciences.

***CS&E – Computational Science and Engineering :***

***The multidisciplinary field concerned with the study, development, and use of computational methods and computers to enable scientific discovery and engineering applications.***



## **CSEM Leadership** (2024)

- Dr. Karen Willcox, Director of the Oden Institute
- Dr. Todd Arbogast, Chair of the Graduate Studies Committee (GSC)
- Dr. George Biros, Graduate Advisor
- Ms. Stephanie Rodriguez, Graduate Coordinator
- CSEM oversight: The Graduate Studies Subcommittee (GSSC)

## Program Outcomes

*1. Education and training*

Each student will develop technical understanding of and graduate level proficiency in computational science, engineering, and mathematics, as defined by three interdisciplinary CSEM Concentration Areas.

*2. Interdisciplinary Research*

Each CSEM Ph.D. student will do original, interdisciplinary research in applied mathematics and computational science and engineering.

*3. Communication Skills*

Each student will be able to communicate research results intelligibly to a broadly trained audience, both in written and oral form. CSEM students will learn skills required to work in research groups to solve complex interdisciplinary problems.

*4. The Scientific Community*

The student will develop a broad understanding of the field of computational science and engineering, both inside and outside of his or her chosen field of application (Area C).

*5. Employment*

Each graduate will secure an entry level position in academia or a public or private research laboratory specializing in interdisciplinary computational science and engineering research or technical services.

# Some Statistics of the CSEM program

*2023–24*

- 103 Students Enrolled
- 92 (89.3%) Ph.D. Students
- 43 (46.7%) Ph.D. Students on Fellowship
- 55 (53.4%) U.S. Students
- 8 (14.5%) U.S. Underrepresented Minorities (in STEM)
- 24 (23.3%) Female
- 35 CAM Option/57 CSE Option/11 Masters Only
- Doctorate Degrees Awarded:
  - 11 in 2020–21
  - 13 in 2021–22
  - 10 in 2023–24
- 6 Average Years to Degree Completion (4 after the Masters)
- About 15-20 new Ph.D. students enrolled each year

# Degree Requirements

# CSEM Degrees

*Master's Program*

The M.S. Degree. A two year program of coursework in the 3 concentration areas (with or without a report or thesis).

Joint B.S. and M.S. Degree. A five year program leading to a B.S. degree and an M.S. in CSEM.

- B.S. in Computer Science
- B.S. in Computational Engineering

*Doctor of Philosophy Program*

A single Ph.D. Degree. A 4-6 year program culminating in a dissertation describing original research.

The Graduate Portfolio in Computational Medicine

- Joint with the Dell Medical School
- Four course requirement recognized on the student's transcript

# Web Sites

*The CSEM web site:*

`https://www.oden.utexas.edu/academics/`

*Degree requirements:*

- The CSEM Ph.D. requirements:

  `https://www.oden.utexas.edu/academics/phd-program/`
- The CSEM M.S. requirements:

  `https://www.oden.utexas.edu/academics/masters-program/`

*The Portfolio in Computational Medicine:*

`https://www.oden.utexas.edu/academics/computational-medicine-portfolio/`

*These slides:* (from T. Arbogast's home page)

`http://users.oden.utexas.edu/%7Earbogast/CSEMoverview.pdf`

*CSEM Wiki page:*

`https://wiki.oden.utexas.edu/csem`

## CSEM Masters Degree

*Options.* Fulfill one of the following

1. Thesis and 24 credit hours of coursework plus 6 credit hours of thesis preparation (30 credit hours total);
2. Report and 30 credit hours of coursework plus 3 credit hours of report preparation (33 credit hours total);
3. 36 credit hours of coursework. Note: Ph.D. candidates will fulfill this requirement. Be sure to request your degree!

This is a two-year program of study. (A full graduate load is 3 courses or 9 credit hours per semester).

*Requirements.*

- Course selection must be approved by the Graduate Advisor.
- At least 24 hours taken for a letter-grade in the 3 CSEM Areas.
- At least 6 hours in each CSEM Area.
- All Graduate School requirements must be fulfilled.
- Overall grade point average 3.0 (B) or better.
- Reports and Theses require an advisor from the CSEM GSC and a reader to approve the document.

## Master's Report vs. Thesis

No university document distinguishes clearly between a report and a thesis in terms of length or scope.

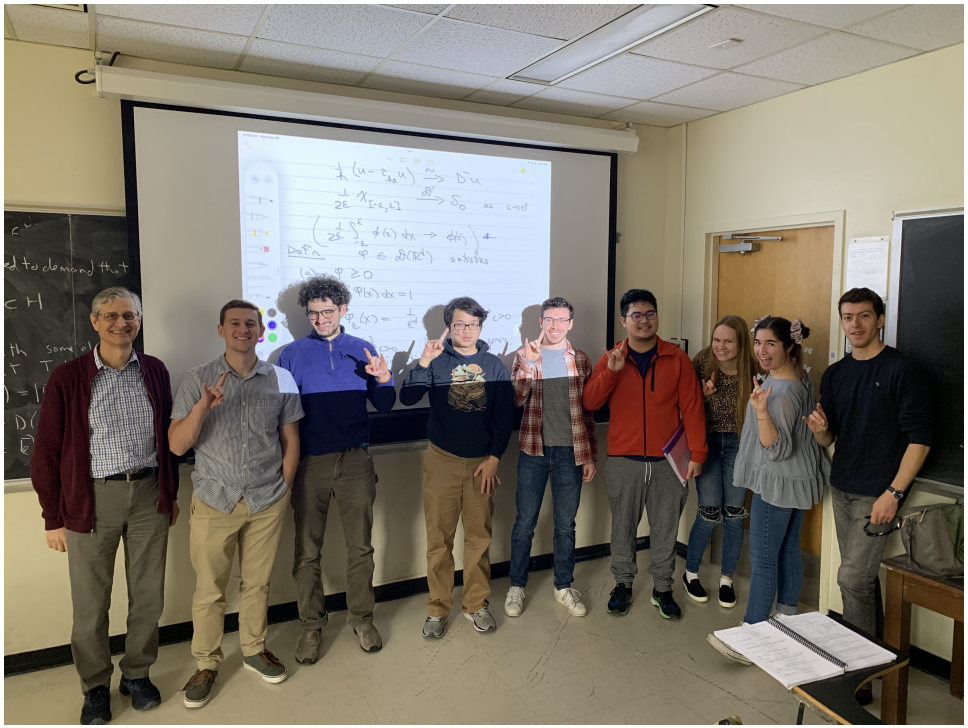
*CSEM policy:*

- A report is a library project, reviewing what scholars have said about a particular topic.
- A thesis is an original contribution to knowledge in which a novel analysis or argument is offered, a problem is analyzed using a new or previously untried framework, or data about a subject is collected and analyzed.
- The work required to produce the document is expected to be equivalent to 3 credit hours for a report and 6 for a thesis.

# CSEM Ph.D. Degree

1. Coursework. 12 courses total, 4 in each of the 3 areas. 6 core courses required in the first year. GPA 3.25 or better.
2. Preliminary Exams. Areas A, B, and C exams at end of first year.
3. Ph.D. Dissertation Committee. The adviser, faculty from Areas A, B, and C, and 1 more. At least 3 from different UT departments.
4. Admission to Ph.D. Candidacy. Student proposes plan of research.
   - Abstract. How Areas A, B, and C form an integral part of the proposed research. Approved by GSSC.
   - Dissertation proposal. Approved by the Dissertation Committee.
   - Candidacy exam. Tests depth and breadth of knowledge. Administered by the Dissertation Committee.
5. Ph.D. Degree. Dissertation and oral defense.

# 1. Coursework



# Ph.D. Degree Options

*Two starting points (the two degree options):*

1. Computational and Applied Mathematics (CAM) Option
   [more math, less applications background]
2. Computational Science and Engineering (CSE) Option
   [more applications, less math background]

Upon entering the program, each student must elect an option.

The key question is: Can you handle graduate level mathematics?

*The single ending point (a single degree):*

Doctor of Philosophy with a major in Computational Science, Engineering, and Mathematics

## Required Grade Point Average

CSEM Concentration Area work

- Cumulative GPA 3.25 (B/B+) or better
- One area GPA of 3.5 (B+/A-) or better

*Remark:* Texas uses the following grade scale.

| | | | |
|---|---|---|---|
| $A$ | 4.00 grade points | $C$ | 2.00 grade points |
| $A-$ | 3.67 grade points | $C-$ | 1.67 grade points |
| $B+$ | 3.33 grade points | $D+$ | 1.33 grade points |
| $B$ | 3.00 grade points | $D$ | 1.00 grade points |
| $B-$ | 2.67 grade points | $D-$ | 0.67 grade points |
| $C+$ | 2.33 grade points | $F$ | 0.00 grade points |

You must maintain a B average to remain in graduate school.

## First Semester

Three required courses on foundational material of CSEM.

Area A. Functional analysis

- CAM: CSE 386C/M 383C Methods of Applied Mathematics I
- CSE: CSE 386M/EM 386M Functional Analysis in Theoretical Mechanics

Area B. Numerical linear algebra

- CSE 383C/CS 383C Numerical Analysis: Linear Algebra

Area C. Applications and modeling

- CSE 389C Introduction to Mathematical Modeling in Science and Engineering I

## Second Semester

Three required courses on foundational material of CSEM.

Area A. Mathematical Methods

- CAM: CSE 386D/M 383D Methods of Applied Mathematics II
- CSE: CSE 386L/EM 386L Mathematical Methods in Engineering and Science

Area B. One course chosen from:

- CSE 383L/M 387D Numerical Treatment of Differential Equations
- CSE 3832M Foundational Techniques of Machine Learning and Data Sciences

Area C. Applications and modeling

- CSE 389D Introduction to Mathematical Modeling in Science and Engineering II

## Next Five Semesters

Complete all coursework by *7th* semester (December 2027)

Area A. Two approved graduate courses (total 4 courses or 12 hours)

- At least 2 courses must be listed or cross-listed with the Mathematics Department.

Area B. Two approved graduate courses (total 4 courses or 12 hours)

- Optional CSE 380 Tools and Techniques in Computational Science
  If you are not already an expert, please take this course!
- One course could be at the undergraduate level, if appropriate.

Area C. Two approved graduate courses (total 4 courses or 12 hours)

- In a field consistent with the student's proposed research area.
- One course could be at the undergraduate level, if appropriate.
- Approved by both the student's dissertation advisor and the Graduate Advisor.

# 2. Preliminary Examinations

## Preliminary Examinations

- Three written exams are given at the end of first year:
  - Area C Wednesday, May 15, 2025;
  - Area B Friday, May 17, 2025;
  - Area A Monday, May 20, 2025.
- Covers the material of the 6 required first year courses (each student is tested on the courses he or she took).
- The student must demonstrate graduate level proficiency in the foundational material of the CSEM Concentration Areas.

- Failure of an exam results in one of:
  - repeat that particular exam the following year, May 2026;
  - take a make-up exam before the start of the Fall semester 2025 (if fail, repeat the exam May 2026);
  - leave the program (almost certainly not until after May 2026).
- Success gives you confidence to concentrate on Ph.D. level research.

# 3. Ph.D. Dissertation Committee

## Dissertation Advisor

The CSEM Graduate Studies Committee (GSC) consists of the faculty who can advise Ph.D. students (a list is on the CSEM web page).

Every student must select an advisor willing to supervise his or her dissertation and give advice on course work. You must find an advisor during your first year, that is, by May 2025.

Prior to this, the Graduate Advisor and possibly a faculty mentor will advise the student on course work.

# The CSEM Graduate Studies Committee

All faculty have home departments

Total faculty: 55 (3 in two departments)

*College of Natural Sciences faculty (23):*

- 9 Mathematics
- 4 Computer Science
- 4 Physics
- 3 Integrative Biology
- 2 Chemistry
- 1 Astronomy

*Cockrell School of Engineering faculty (29):*

- 12 Aerospace Engineering & Engineering Mechanics
- 6 Mechanical Engineering
- 4 Biomedical Engineering
- 3 Chemical Engineering
- 2 Petroleum & Geosystems Eng.
- 1 Electrical & Computer Eng.
- 1 Civil & Environmental Eng.

*Other Units of the University (6):*

- 4 Jackson School of Geosciences
- 2 Dell Medical School

## Ph.D. Dissertation Committee

- The dissertation committee consists of the advisor and faculty from:
  1. area A;
  2. area B;
  3. area C;
  4. any relevant faculty outside the GSC.
- At least three must be in distinct UT departments through positive time appointment.
- The Graduate Advisor must approve the committee.

# 4. Admission to Ph.D. Candidacy

Before the end of the sixth semester (August 2027),
the student must propose research for the Ph.D. dissertation.

## Proposal Abstract

*Write:* Write a concise abstract of the dissertation proposal.

- About 0.5 page listing the proposal title, your name, advisor, and committee members.
- About 0.5 to 1 page giving general background on the research area and identification of the problems to be addressed.
- About 1 to 1.5 pages discussing how Areas A, B, and C will form an integral part of the proposed research.
- The text of the abstract content (not titles, etc.) must fit in 2 pages.
- Perhaps 0.5 page of important references and possibly courses taken.

*Meet:* Meet with each member of the dissertation committee to discuss:

- the abstract
- the role of the committee member
- the background knowledge expected of the student and types of questions that might be asked at the proposal presentation

The abstract must be signed by each member of the committee.

*Submit:* Submit to the GSSC for approval. Allow at least 1 month!

Is the research interdisciplinary and draw on Areas A, B, and C?

## Proposal Document

The proposal must be set in 11 or 12 point font and conform to standard U.S. letter dimensions using one inch margins.

1. Title page. Title, student, date, committee.
2. Proposal abstract.
3. Description of the proposed work. At most 20 pages.
   a. Technical background and relevant literature
   b. Objectives, significance, and originality
   c. Work completed to date
   d. Work yet to be completed and methodology or approach
4. References.
5. Vita. One to two page vita: degrees earned, awards, papers published or in preparation, and technical talks or posters.
6. Timeline. To complete the proposed work.
7. Appendices. At most 10 pages of additional material.

*Remark.* The structure is like a research grant proposal.

## Admission to Ph.D. Candidacy

Two weeks past submission of the dissertation proposal.

*Part 1:* Private oral presentation to the committee, about 45 minutes.

*Part 2:* Qualifying examination by the committee, about 1 hour.

- Explore details of the proposal
- Test depth and breadth of background knowledge relevant to the proposed research
- Test ability to integrate ideas from areas A, B, and C

- Failure: require additional course work and examination within 1 year.

*Part 3:* Graduate School application for admission to Ph.D. candidacy.

# 5. Ph.D. Degree

## Ph.D. Dissertation and Defense

*Dissertation:* A written dissertation ("long essay") of research results, generally advocating a coherent thesis ("a statement or theory put forward as a premise to be maintained or proved").

*Defense:*

- Public, oral seminar presentation of about 45 minutes plus questions.
- Private meeting with the dissertation committee to face questions and orally defend the work.

The dissertation committee must approve both the dissertation and the defense.

- Should complete by the end of the tenth long semester (May 2029).
- In a practical sense, must be completed before the end of the fourteenth long semester (May 2031).

The dissertation and oral defense must follow appropriate Graduate School requirements and procedures.

# 6. Miscellaneous

## Oden Institute Seminars

- **Research seminars:** Research seminars most Tuesdays and Thursdays at 3:30 in the seminar room, POB 6.304.
- **Local presentations:** (Organized and hosted by CSEM students)

  The Babuška Forum. Biweekly seminar series exposes students to interesting and curious topics relevant to computational science and engineering at the graduate student level.

  The Student Forum. Biweekly seminar series gives CSEM students the opportunity to share their work with peers, encourage collaboration, and provide opportunities to practice presentation skills.


Professor Ivo Babuška (1926–2023)
Conference honoring his 90th birthday

Your attendance is required! (10 seminars per semester)

## Annual Progress Reports

Each student must fill out an annual Student Progress Report:

- coursework
- financial support
- research activities
- dissertation committee (if known)
- area C concentration
- expected date for proposal (if known)
- expected date for defense (if known)
- etc.
- Signed by the Advisor

Asks for problems/delays encountered

Due before the start of the academic year

Feedback is given regarding

- Timely progress (or the lack thereof)
- Warnings of upcoming milestones
- Probationary issues

## Probation and Petitions

*Probation:* A student failing to satisfy the requirements of the program in a timely manner will be put on probation by the GSSC, and his or her progress will be monitored closely. The student will stay on probation until satisfactory progress is achieved. A student may stay on probation for a maximum of two long semesters.

*Appeals and Petitions:* The student may appeal to or petition the CSEM GSSC for waiver or alteration of any CSEM requirement, except for waiver of an exam or waiver of a Graduate School degree requirement.

# Summary

# First Year Summary

- Courses
  - 2 Area A
  - 2 Area B
  - 2 Area C
- Preliminary Examinations in late May
- Seminar attendance (10 per semester)
- Selection of dissertation advisor by May 2025
- Annual progress report (due late summer 2025)

  Formulate a coherent area of application (Area C)!
  - Study the area you are trying to impact.
  - Engage the science, engineering, and/or social science disciplines.
  - Mathematics and computer science give tools (Areas A & B) out of context. The application area is the context.

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3. Ph.D. Dissertation Committee. The adviser (select by end of year), faculty from Areas A, B, and C, and 1 more. At least 3 from different UT departments.
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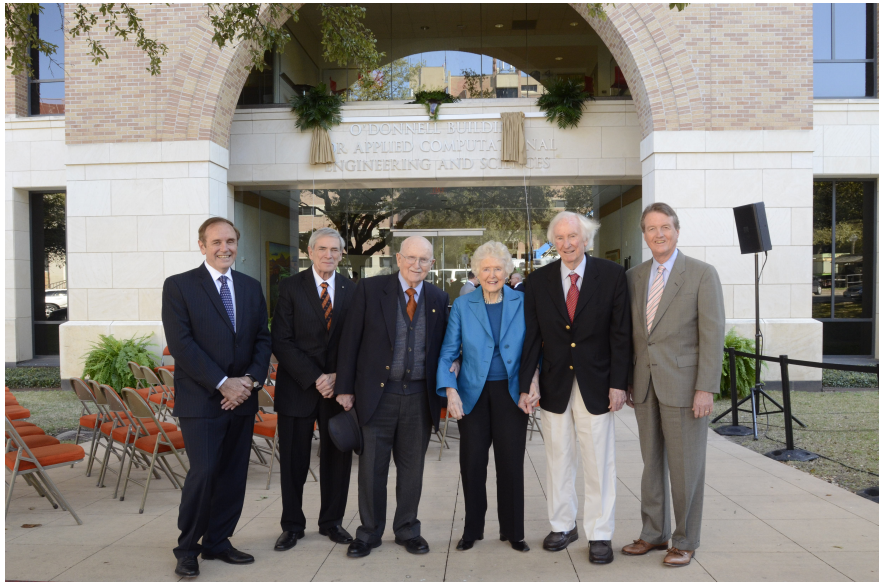
   - Dissertation proposal. Approved by the Dissertation Committee.
   - Candidacy exam. Tests depth and breadth of knowledge. Administered by the Dissertation Committee.
5. Ph.D. Degree. Dissertation and oral defense. Due: August 2028–2031.

# Research Community within the Oden Institute

Some of the Oden Institute Core Faculty



Peter O'Donnell, Jr. Building for Applied Computational Engineering & Sciences (POB)

# Building Community

## *Within CSEM*

- Everyone is in the Peter O'Donnell Building.
- A total of 204 graduate students work in the Institute (99 CSEM).
- Weekly coffee hours.
- Common first year students' courses and offices.
- Student Lounge.
- CSEM student leaders organize socials and bring concerns to faculty.

## *Outside CSEM*

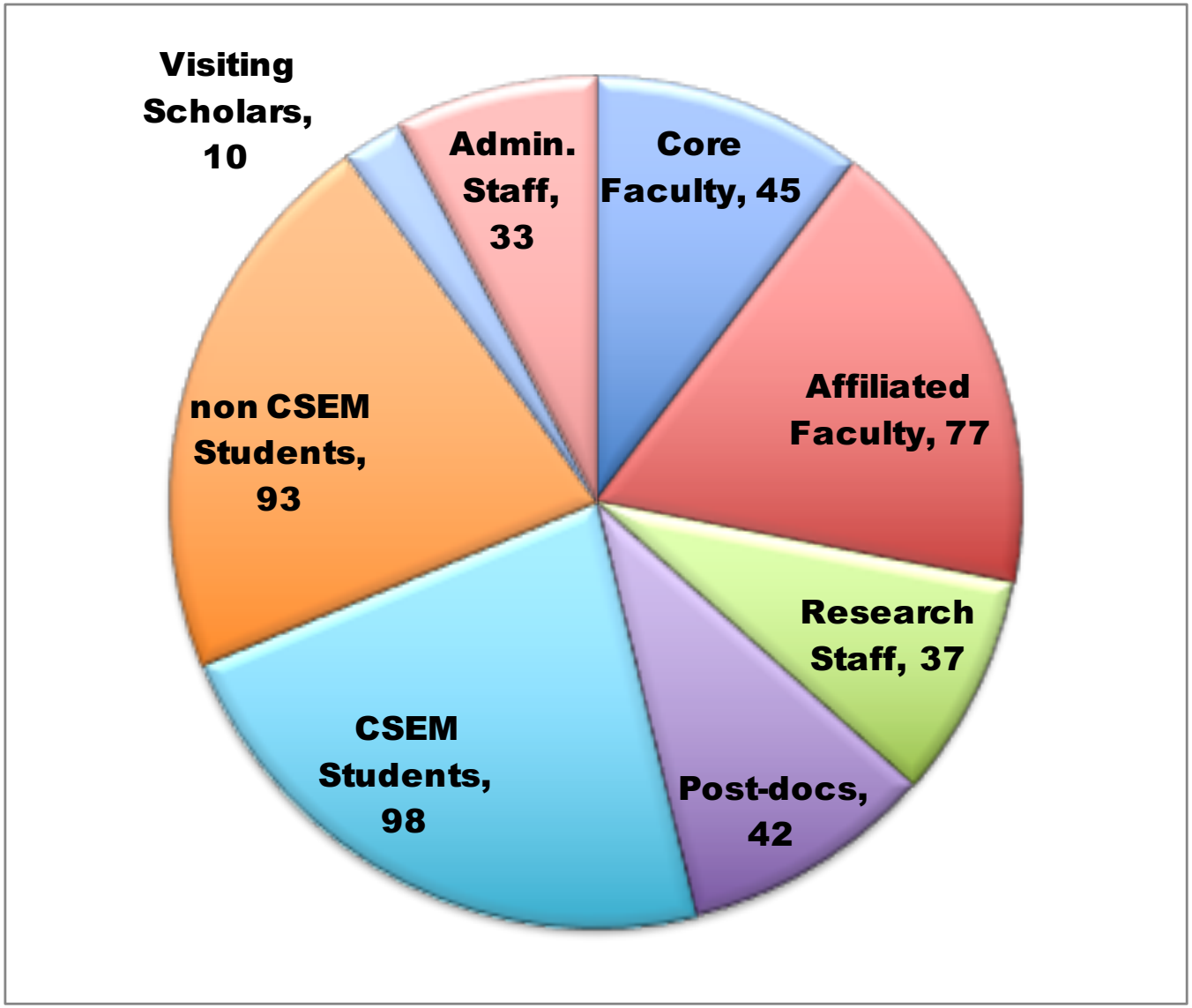
- Student chapter of the Society for Industrial & Applied Math. (SIAM), for all those interested in mathematics and its applications: any major, undergraduate, graduate, and faculty.

Peter O'Donnell, Jr. Building for Applied Computational Engineering & Sciences

O's Patio

# Oden Institute Researchers

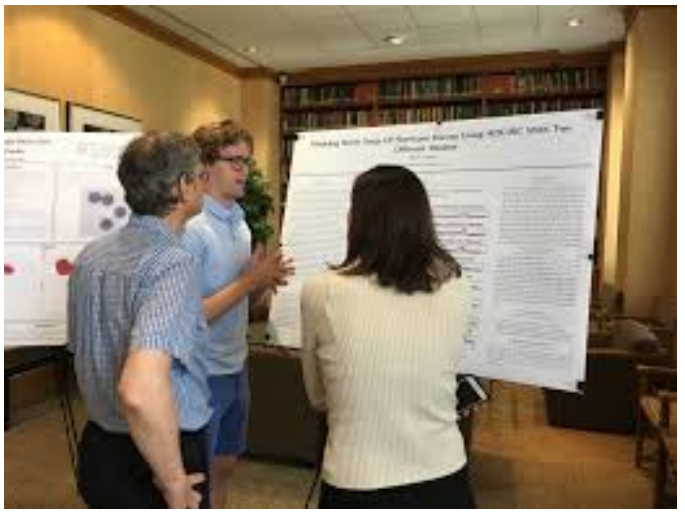
The Oden Institute is home to more than 400 People!



# Oden Institute's 25 Research Centers—1

*Life Sciences and Medicine (3)*

- Center for Computational Life Sciences and Biology (Elber, Ren)
- Center for Computational Oncology (Yankeelov, Biros, Virostko)
- Willerson Center for Cardiovascular Modeling and Simulation (Sacks, Hughes)



*Physical Sciences (6)*

- Center for Computational Materials (Chelikowsky, Demkov)
- Center for Computational Molecular Sciences (Henkelman, Bonnecaze, Makarov)
- Center for Quantum Materials Engineering (Giustino)
- Computational Astronautical Sciences and Technologies (Jah, Jones, Zanetti)
- Computational Mechanics Group (Hughes et al.)
- Electromagnetics and Acoustics Group (Demkowicz, Torres-Verdin)

# Oden Institute's 25 Research Centers—2

*Geosciences (3)*

- Center for Subsurface Modeling (Wheeler, Arbogast, Delshad)
- Computational Hydraulics Group (Dawson)
- Computational Research in Ice and Ocean Systems Group (Heimbach)

*Computational Hydraulics Group.*
*Group Lead - Clint Dawson.*

# Oden Institute's 25 Research Centers—3

*Computational Science and Engineering (7)*

- Center for Autonomy (Topcu, et al.)
- Multiscale Engineering, Mathematics and Sciences Group (Aluru)
- Optimization, Inversion, Machine Learning, and Uncertainty for Complex Systems (Ghattas, Bollapragada)
- Parallel Algorithms for Data Analysis and Simulation Group (Biros)
- Predictive Engineering and Computational Sciences (Moser et al.)
- Probabilistic and High Order Inference, Computation, Estimation, and Simulation (Bui-Thanh)
- Willcox Research Group (Willcox)

*Mathematics and Computer Science (6)*

- Applied Mathematics Group (Gamba et al.)
- Center for Distributed and Grid Computing (Pingali)
- Center for Numerical Analysis (Engquist et al.)
- Center for Scientific Machine Learning (Bui-Thanh, Offner, et al.)
- Computational Visualization Center (Bajaj)
- Science of High-Performance Computing Group (Van de Geijn)

# Oden Institute Research Metrics

| Faculty Metric | 2019-20 | 2020-21 | 2021-22 | 2022-23 |
|---|---|---|---|---|
| Affiliated Faculty | 122 | 121 | 127 | 132 |
| Core Faculty | 46 | 50 | 51 | 49 |
| Medals, Prizes & Honors | 82 | 73 | 60 | 82 |
| Refereed Journal Publications | 384 | 362 | 401 | 347 |
| Total Citations | 902,665 | 937,450 | 999,476 | 1,085,400 |
| Editorial Boards | 163 | 186 | 185 | 129 |
| Seminars & Lectures | 350 | 413 | 475 | 525 |
| Workshops Hosted | 2 | 3 | 4 | 9 |
| Active Research Projects | 207 | 197 | 217 | 220 |
| Total Funding | $74.1M | $89.6M | $108.6M | $110.6M |
| Income | $21.2M | $29.3M | $34.7M | $118.8M |
| Expenses | $19.6M | $21.5M | $25.8M | $27.3M |

| Student Metric | 18-19 | 19-20 | 20-21 | 21-22 | 22-23 |
|---|---|---|---|---|---|
| Total enrollment | 80 | 98 | 101 | 106 | 101 |
| Authored or coauthored articles | 41 | 41 | 45 | 49 | 48 |
| Presented papers/seminars | 40 | 35 | 53 | 53 | 47 |
| Attended professional meetings | – | – | – | 46 | 51 |

# Recent CAM/CSEM Ph.D. Graduates

Graduation 2022

# 2022-23 CSEM Ph.D. Dissertations

1. Investigating and Modeling Turbulence Using Numerical Simulations, Prakash Mohan, May 2023, Advisor: Robert Moser
2. Predictive Modeling and Uncertainty Quantification for Diblock Copolymer Self-Assembly, Lianghao Cao, Dec 2022, Advisor: J. Tinsley Oden; Co-advisor: Omar Ghattas
3. Coupled Phenomena in Thin Layers, Kirill Rebrov, Dec 2022, Advisor: Greg Rodin
4. Randomized Dimension Reduction with Statistical Guarantees, Yijun Dong, Aug 2023, Advisor: Per-Gunnar Martinsson, Co-advisor: Rachel Ward
5. Reliable Hierarchical Matrix Compression Methods and Their Efficient Parallelization for Integral-Equation Based Rcs Prediction, Jonathan Kelley, Dec 2022, Advisor: Ali Yilmaz
6. Data-Driven Parametric Reduced-Order Models: Operator Inference for Reactive Flow Applications, Shane McQuarrie, Aug 2023, Advisor: Karen Willcox
7. Computational Modeling of Protein Fluorosequencing, Matthew Smith, Aug 2023, Advisor: Edward Marcotte
8. WAVEx: A New Spectral Wind Wave Model Using Stabilized Finite Elements, Mark Loveland, May 2023, Advisor: Clint Dawson
9. A-Contrario Space Surveillance: Multiple Hypothesis Testing for Object Detection and Tracking in Telescope Imagery, Bejmain Feuge-Miller, Aug 2023, Advisor: Moriba Jah
10. Accelerating Inverse Solutions with Machine Learning and Randomization, Jonathan Wittmer, May 2023, Advisor: Tan Bui-Thanh

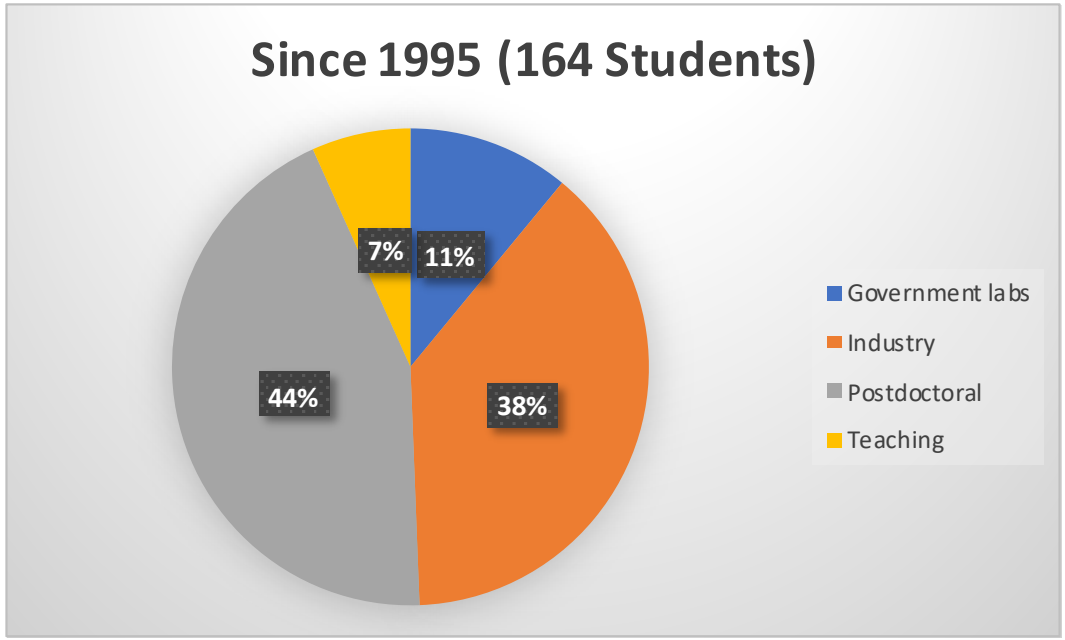
# 2021–2022 CSEM Ph.D. Dissertations

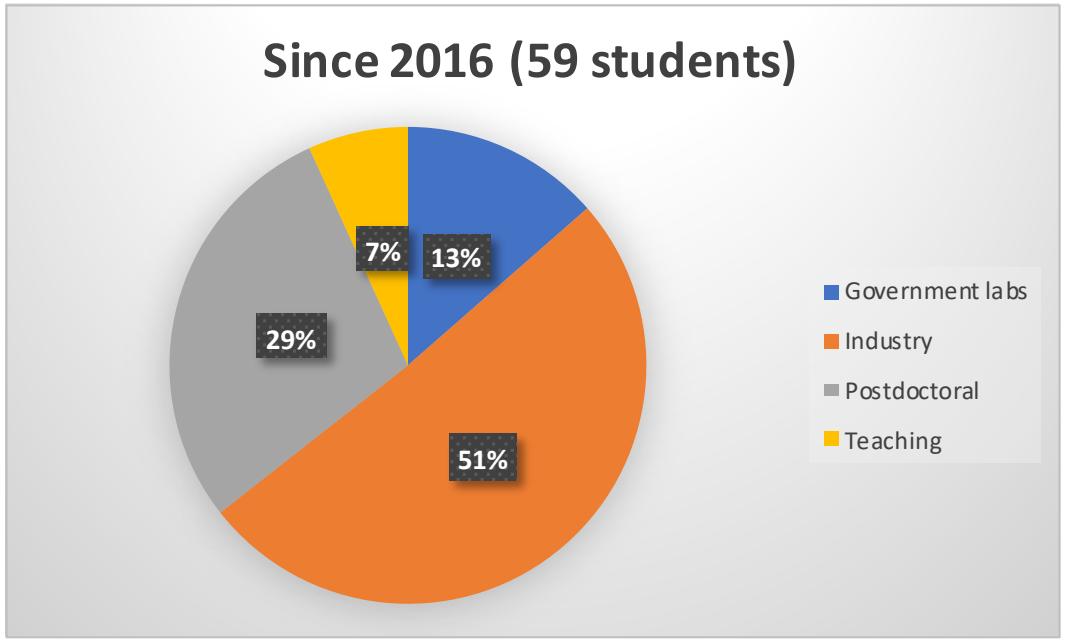
1. Numerical Methods for Fast Simulation of a Red Blood Cell, Agarwal, Dhwanit, May 2022, Advisor: George Biros
2. Discrete Representation of Elastic Bodies for Physical Simulation, Chen, Hsiao-yu, Aug 2022, Advisor: Mary Wheeler & Etienne Vouga
3. Abstractions In Python For Utilizing Diverse Hardware For Applications In Computational Science, Henriksen, Ian, Dec 2021, Advisor: Keshav Pingali
4. High Performance Algorithms for Medical Image Registration with Applications in Neuroradiology, Himthani, Naveen, May 2022, Advisor: George Biros
5. Randomized Algorithms for Revealing Hidden Structure in Data-Sparse Matrices, Levitt, James, May 2022, Advisor: Per-Gunnar Martinsson & George Biros
6. Topology optimization and uncertainty quantification using component-wise reduced order modeling, McBane, Sean, Aug 2022, Advisor: Karen Willcox & Choi
7. Machine Learning Methods for Community Detection in Networks Using Known Community Information, Palukuri, Meghana, Aug 2022, Advisor: Edward Marcotte
8. Development, Calibration, and Prediction of Mathematical Models of Tumor Growth and Angiogenesis, Phillips, Caleb, Aug 2022, Advisor: Tom Yankeelov
9. Uncertainty Quantification of Ocean Driven Melting Under the Pine Island Ice Shelf, Smith, Timothy, Dec 2021, Advisor: Patrick Heimbach
10. Adaptive and Weighted Optimization for Efficient and Robust Learning, Xie, Yuege, Aug 2022, Advisor: Rachel Ward
11. Homogenization Techniques For Constitutive Modeling In Peridynamics: From Analytical Methods To Machine Learning, Xu, Xiao, May 2022, Advisor: John Foster
12. Numerical Discretization Effects in Large Eddy Simulation of Turbulence, Yalla, Gopal, May 2022, Advisor: Robert Moser & Bjorn Engquist
13. Cardiac Simulations Using a Neural Network Finite Element Method, Zhang, Wenbo, May 2022, Advisor: Michael Sacks

# 2020–2021 CSEM Ph.D. Dissertations

1. PolyDPG: A Discontinuous Petrov-Galerkin Methodology for Polytopal Meshes with Applications to Elasticity, Jaime Mora Paz, 2020, Advisor: Leszek Demkowicz.
2. Parameter Selection in Seismic Processing Problems, Luke Decker, 2021, Advisor: Sergey Fomel.
3. A Scalable Hp-Adaptive Finite Element Software with Applications in Fiber Optics, Stefan Henneking, 2021, Advisor: Leszek Demkowicz.
4. Coupling of a Nonlinear Dispersive Water Wave Model with Sediment Transport and Seabed Morphodynamic Models for Application in Near-Shore Areas, Kazbek Kazhyken, 2021, Advisor: Clint Dawson.
5. A Reacting Jet Direct Numerical Simulation for Assessing Combustion Model Error, Bryan Reuter, 2021, Advisor: Robert Moser.
6. Isogeometric Analysis-Suitable Geometry: Rebuilding CAD Surface Geometries Via Quadrilateral Layouts, Kendrick Shepherd, 2021, Advisor: Thomas Hughes.
7. Components and Principles of Streaming Principal Components, Amelia Henriksen, 2021, Advisor: Rachel Ward.
8. Data-Driven Modeling for Compound Flooding Simulation, Wei Li, 2021, Advisor: Clint Dawson.
9. Side Information, Robustness and Self-Supervision in Imitation Learning, Farzan Memarian, 2021, Advisor: Ufuk Topcu.
10. High-Performance Inversion Algorithms for Brain Tumor Growth Models in Personalized Medicine, Shashank Subramanian, 2021, Advisor: George Biros.
11. Imitation Learning from Observation, Faraz Torabi, 2021, Advisors: Peter Stone & Inderjit Dhillon.

# CSEM First Job After Graduation



# Recent CSEM Employment

## Industry

- Adobe
- Akuna Capital, LLC
- Amazon, Inc.
- Ansys
- Apple
- Cadence Design Systems, Inc.
- CGI
- Chevron
- Enthought, Inc.
- EyeLock
- Facebook
- Goldman Sachs
- Google
- Hewlett Packard Enterprise
- IBM
- Meta
- NVIDIA
- Sales Melody
- Schlumberger
- Snap, Inc.
- SparkCognition
- Spotify
- Suited, Inc.
- Tesla
- Zdaly

## Academics

- Brigham Young University
- Delft University of Technology
- Fundación Universitaria Konrad Lorenz
- Johns Hopkins University
- New York University
- Princeton University
- Technical University of Darmstadt
- Technical University of Denmark
- University of Basel
- University of Colorado - Boulder
- University of Hannover
- University of Texas at Austin

## Government

- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Security, LLC.
- Sandia National Laboratories
- Southwest Research Institute

**Welcome to CSEM!**

We hope your time here is stimulating, challenging, rewarding, and **enjoyable!**