Newsjournal of the Society for Industrial and Applied Mathematics sinews.siam.org

siam news

Volume 59/ Issue 1
January/February 2026

The Physics of Surfaces: Why City Growth is So Rough

By Matthew R. Francis

Cities are extraordinarily complex systems. Some of the fastest-growing urban centers, many of which are in Asia and Africa, involve an intricate combination of social, economic, geographical, topographical, and political factors to understand their structures. City expansion also places unprecedented stress on the environment, necessitating new ways of thinking about land and resource management. Collectively, these complications make any sort of city modeling a daunting endeavor.

Nevertheless, mathematically minded researchers routinely rise to the challenge. A recent effort draws on the physics of surfaces, which studies the organization of atoms and molecules on a substrate according to the properties of both the added particles and the surface on which they land. This work attempts to find new ways to model city growth that are as independent as possible from the particular socioeconomic and geographic details that make each city unique.

"Most of the studies so far considered the growth of a one-dimensional (1D) surface, so the [city] grows in just one direction," Marc Barthelemy, a theoretical physicist at the Institut de Physique Théorique in France, said. In other words, many existing mathematical models and simulations for city expansion are based on bacterial growth and assume a rotationally symmetric city. In contrast, a surface physics-based approach allowed Barthelemy and his collaborators to include spatial irregularities in structure. "A city is also extremely anisotropic," he said. "You cannot look at a city, take a central point, and say on average that its shape will be a circle."

By moving beyond the 1D model, the team applied well-established techniques from surfaces. In a recent paper [2], they extracted several universal properties from urban data, including the local "roughness" of a city boundary. "To my knowledge, it is the first paper that tries this sort of measure of growing surfaces on cities," Barthelemy said, explaining that the work appeals to his background in statistical physics. The group also determined that real-world cities don't correspond to established universality classes from surface growth models — a realization that stands in strong disagreement with 1D approaches.

What is a City, Anyway?

From a social-scientific viewpoint, residential, commercial, industrial, and recreational factors—such as total population, roads, and land use—often take precedence over the shape and physical extent of a city. However, these factors are not independent of any pure size-and-shape considerations. For example, a 2020 study based on Landsat data[1] estimated nearly 10,000 square kilometers of urban growth per year between 1985 and 2015 [1], with increased impacts on resources and the environment.

Even so, *actually* measuring the physical size and growth of cities is difficult. High-resolution spatial data for many parts of the world have only been available since the advent of Landsat and other Earth-observation survey satellites in the 1970s — a relatively short time window in which to measure change, particularly acceleration in growth rates.

Additionally, researchers must define a "city" in a strictly quantitative (rather than political) sense. A major U.S. urban area, for instance, may consist of a city core, suburbs, exurbs, and unincorporated zones that extend past various divisions for taxation or government purposes; from a geometrical measurement point of view, however, they all comprise one unit. For example, the aforementioned 2020 study used surface reflectance to measure city extent, which is different for settled areas versus undeveloped land, farms, or even smaller communities [1].

For their analysis, Barthelemy and his collaborators employed a city clustering algorithm from percolation theory [3] to identify the largest connected clump of any city in their datasets. They excluded growth that stemmed from the absorption of smaller population centers, which accounts for significant physical expansion of cities. Consider London, which has gradually expanded beyond its ancient boundaries over several centuries to encompass nearby towns like Kensington—now completely part of the city—as well as independent cities like Greenwich that are effectively continuous.

Thanks to government census-taking, city populations offer the best available data. To track physical growth, Barthelemy's team hence turned to the World Settlement Footprint (WSF) Evolution dataset[2] from Germany's Earth Observation Center.[3] WSF Evolution utilizes Landsat satellites to map urban growth for the whole planet between 1985 and 2015, with the obvious caveats that these observations have significantly improved over the years and

See **City Growth** *on page 4*

[1] https://science.nasa.gov/mission/landsat

[2] https://geoservice.dlr.de/web/datasets/wsf_evo

[3] https://www.dlr.de/en/eoc

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Real-time Bayesian Inference With Full Physics Models: A Digital Twin for Tsunami Early Warning

By Stefan Henneking, Sreeram Venkat, Veselin Dobrev, John Camier, Tzanio Kolev, Milinda Fernando, Alice-Agnes Gabriel, and Omar Ghattas

Although rare, tsunamis can be extremely deadly and cause catastrophic socioeconomic losses that amount to hundreds of billions of dollars in damage. State-of-the-art tsunami early warning systems typically infer earthquake moment magnitude and hypocenter location, then use precomputed scenarios or simplified fault models to trigger tsunami forecasts within minutes. However, the seismic information on which these systems rely is based on simplified assumptions that often fail to capture the complexities of earthquake rupture dynamics [6], which can lead to delayed, missed, or false warnings.

To address some of the shortcomings of existing systems, we present a full-physics Bayesian inversion and prediction framework—a so-called *digital twin* [8]—that enables accurate, data-driven tsunami forecasting with dynamic adaptivity to complex source behavior. Our approach aims to improve warning capabilities by directly integrating real-time ocean bottom pressure data to constrain tsunami sources without relying on assumed fault geometry or magnitude. We utilize the *acoustic-gravity wave equations*—a partial differential equation (PDE) model that couples the propagation of ocean acoustic waves with surface gravity waves [7]—to model the tsunami dynamics of our digital twin. Based on this physics model, the inversion framework employs ocean bottom pressure data to statistically infer earthquake-induced spatiotemporal seafloor motion in real time. The solution of this Bayesian inverse problem is then used to simulate tsunami propagation toward coastlines and forecast wave heights at specified locations with quantified uncertainties.

This work falls into an important class of problems called *inverse problems*, which are fundamental to many fields of science and engineering. In a *forward problem*, the input parameters (e.g., initial or boundary conditions, coefficients, or source terms) are specified; the governing equations' solution then yields the state variables that describe the system's behavior. However, forward models typically contain uncertain parameters that are often infinite-dimensional fields that can vary in space (and possibly time). Inverse problems hence seek to infer uncertain parameter fields from measurements or observations of system states.

Infinite-dimensional inverse problems are usually ill posed, in that many parameter fields may be consistent with the observational data within the noise [2]. The Bayesian approach treats the uncertain parameter as a random field, and the inverse problem's solution is the *posterior probability distribution*, which characterizes the probability that *any* parameter field is consistent with the data and prior knowledge. As such, the Bayesian framework is a very powerful technique for the characterization of uncertainty in the inverse problem's solution.

But this power comes at a price: computing the full Bayesian solution is generally intractable for infinite-dimensional inverse problems that are governed by PDEs. For example, computing just the mean of the posterior formally necessitates numerical integration in the discretized parameter dimension; each evaluation of the integrand requires solution of the forward problem—which can take hours—and we need numerous forward solutions. The specific Bayesian inverse problem in question is the inference

See **Tsunami Early Warning** *on page 3*

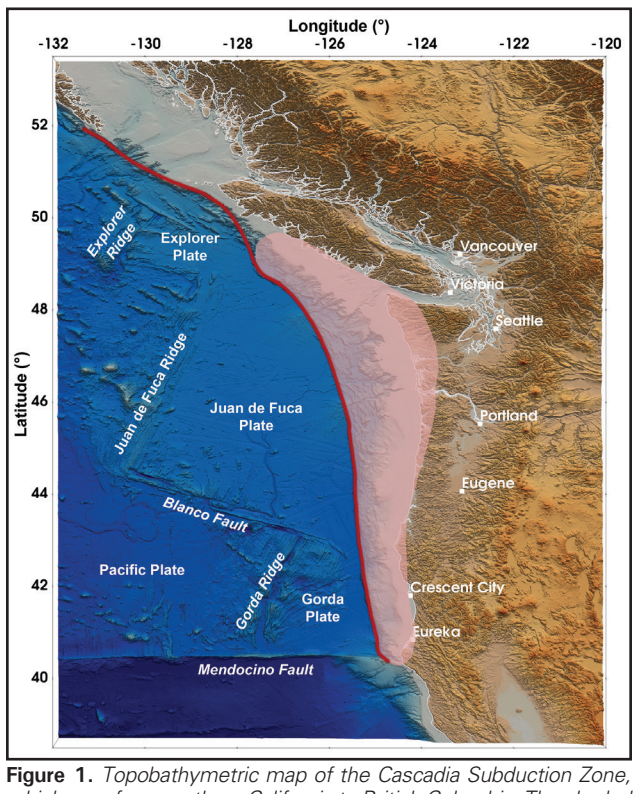

Figure 1. *Topobathymetric map of the Cascadia Subduction Zone, which runs from northern California to British Columbia. The shaded pink area illustrates the potentially "locked" portion of the megathrust interface, and the red line marks the trench where the subducting Explorer Plate, Juan de Fuca Plate, and Gorda Plate begin their descent beneath the North American Plate. Figure courtesy of [4].*

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siam news
Volume 59/ Issue 1/ January/February 2026

SIAM's Newest Leadership Assumes Office

By Lina Sorg

In November 2025, eligible members of the SIAM community voted in the annual election to select the Society's new and returning[1] leadership. SIAM is thus pleased to introduce the incoming President-Elect, Vice President-at-Large, Secretary, three members of the SIAM Board of Trustees, and four members of the SIAM Council.

The President-Elect will shadow current SIAM President Carol Woodward (Lawrence Livermore National Laboratory) throughout 2026 and assume the role of President for the entirety of 2027 and 2028. The newly elected Vice President-at-Large and reelected Secretary began their terms on January 1 and will serve until December 31, 2027. New and returning members of the SIAM Board of Trustees and SIAM Council also took office on January 1 and will retain their positions until December 31, 2028.

Here, SIAM's newest leaders—all of whom have maintained active involvement with the organization in recent years—reflect on their positions and outline their intentions for their time in office. More information about the electees is available online.[2]

The newly elected leadership of SIAM. Top row, left to right: President-Elect Cynthia Phillips (Sandia National Laboratories), Vice President-at-Large Simon Tavener (Colorado State University), Secretary Karen Devine (Sandia National Laboratories, retired), and SIAM Board of Trustees members Bonita Saunders (National Institute of Standards and Technology) and Konstantina Trivisa (University of Maryland). Bottom row, left to right: SIAM Board of Trustees member Ulrike Meier Yang (Lawrence Livermore National Laboratory, retired) and SIAM Council members Luis Chacón (Los Alamos National Laboratory), Rachel Levy (North Carolina State University), Noemi Petra (University of California, Merced), and Jennifer Ryan (KTH Royal Institute of Technology). Photos courtesy of the elected individuals.

President-Elect

Cynthia Phillips (Sandia National Laboratories): "I am so grateful that the SIAM membership has given me the opportunity to serve as President-Elect and then President. It is exciting and very humbling that I will at times be the face of this amazing organization. Though I hope to help SIAM with all of its endeavors, I especially wish to find ways to make our critical conference program more financially sustainable as costs rise and some people choose not to travel."

Vice President-at-Large

Simon Tavener (Colorado State University): "I am surprised and delighted to have the opportunity to serve the SIAM community as Vice President-at-Large. For many of us, SIAM has significantly enhanced our professional development through its conferences and workshops, journals and books, and activity groups and sections. SIAM engages and supports its members from their time as graduate students through their early careers and ultimately to their roles as senior mathematicians in academia and industry. Moving forward, we face several challenges — particularly regarding the role of artificial intelligence and declining public confidence in science. I will seek to make the most of this opportunity to contribute to SIAM and its members as we address these challenges together as an international community of mathematicians."

Secretary

Karen Devine* (Sandia National Laboratories, retired): "I am excited to be reelected as SIAM Secretary, and especially to lead the SIAM Committee on Committees and Appointments (CCA). In 2025, almost 25 percent of new CCA appointments were volunteers: SIAM members with a desire to serve our community in a special way. If you would like to be more involved in SIAM—building your professional network and sharing your time and talent—please volunteer[3] by filling out the online form."

SIAM Board of Trustees

Bonita Saunders* (National Institute of Standards and Technology): "I am extremely honored to be elected to a third term on the SIAM Board of Trustees. I look forward to continuing the Board's work and striving to make informed decisions that support applied and computational scientists throughout the U.S. and abroad. I will maintain efforts to open the lines of communication between SIAM leadership and activity groups or sections, where fiscally sound decisions may not be appreciated as such. More transparency can lead to outcomes that work for both sides, or at the very least, help each side better understand the other."

Konstantina Trivisa (University of Maryland): "I am delighted and grateful to have been elected to the SIAM Board of Trustees. As a member of the SIAM Board, I will use this platform to further the field of applied mathematics and advocate for the essential role of interdisciplinary research in scientific discovery. SIAM plays a critical part in fostering interdisciplinary connections and promoting education and training, and I believe that we can double down on these strengths to help advance science and technology. At the core of a thriving society is a robust, engaged, and diverse membership, and I will serve as a steward for the growth of the Society."

Ulrike Meier Yang* (Lawrence Livermore National Laboratory, retired): "I am very grateful to the SIAM membership for reelecting me to the SIAM Board of Trustees. Topics of interest for SIAM include the use of artificial intelligence and large language models. SIAM needs to carefully evaluate any risks or complications that stem from such tools, as well as potential opportunities that they provide to improve areas within SIAM, such as conferences, publications, and more. SIAM should also continue to pursue diversity—whether it is based on gender, race, geographic location, career stage (from students to senior researchers), or institution type (academia, national labs, or industry)—since this is crucial for the continued generation of fresh ideas and advancement of mathematical and computational research."

SIAM Council

Luis Chacón (Los Alamos National Laboratory): "I am sincerely grateful for the trust that my SIAM colleagues have placed in me by electing me to the SIAM Council. As I begin my first term, I'm eager to learn more about the organization and support its mission. SIAM plays a unique and vital role in connecting researchers from universities, national labs, and industry, and advancing our shared scientific enterprise. Being part of its leadership at such a dynamic moment is a privilege and responsibility that I embrace with humility and deep appreciation."

Rachel Levy (North Carolina State University): "Thank you for the opportunity to serve! One of the wonderful things about running for SIAM Council was the kind words of support from colleagues. I'm looking forward to reengaging in a leadership capacity and hope to be useful to SIAM in my new role by thoughtfully considering the varying perspectives and constituencies within the organization."

Noemi Petra (University of California, Merced): "I am very grateful and honored to have been elected by my colleagues to serve on the SIAM Council. SIAM plays a critical role in advancing applied and computational mathematics across academia, industry, and government, and I am eager to contribute to this mission. I hope to help expand inclusive and accessible opportunities for research exchange, professional development, and mentorship — particularly for members that face barriers to participation. I look forward to working with the Council to strengthen SIAM's leadership in research, education, and outreach."

Jennifer Ryan (KTH Royal Institute of Technology): "I am deeply honored to have been elected to the SIAM Council. SIAM provides a range of venues for intellectual engagement, which is vital to ensuring the continued impact of mathematics on societal and scientific advancements. I look forward to working with SIAM leadership to support activities that provide opportunities for vibrant intellectual exchange and promote collaboration and career development for the next generation."

See **Newest Leadership** *on page 3*

[1] * indicates an incumbent member

[2] https://www.siam.org/publications/siam-news/articles/siam-presents-newest-leadership-2025

[3] https://www.siam.org/about-us/governance-leadership/leadership-suggestions

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Tsunami Early Warning

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and prediction of tsunamis for early warning, which adds a real-time requirement to the aforementioned challenges. Our forecasting goal—to provide early warning in less than a minute—may seem futile, as state-of-the-art inversion methods would call for many years of supercomputing time to solve this problem. However, we achieve real-time performance through a combination of novel parallel inversion algorithms, advanced PDE discretization libraries, and the exploitation of leading-edge graphics processing unit (GPU) supercomputers.

Our digital twin framework [5] combines the following key ideas: (i) offline-online decomposition of the inverse solution that precomputes various mappings to enable the real-time application of the inverse operator and circumvent the need for PDE solutions during inversion; (ii) representation of the inverse operator in the data space instead of the high-dimensional parameter space; (iii) extension of this real-time inference methodology to the goal-oriented setting to predict quantities of interest (QoI) under uncertainty; (iv) exploitation of the shift invariance for the discretized differential operator to reduce the number of PDE solutions by several orders of magnitude; and (v) exploitation of this same property to perform efficient fast-Fourier-transform-based and multi-GPU-accelerated Hessian matrix-vector products (matvecs) [9].

The solution of inverse problems requires numerous Hessian matvecs, each of which comes at the cost of a pair of forward/adjoint PDE solutions. PDE solutions are computationally expensive for large-scale problems, which means that we cannot perform them in real time. One key innovation that enables real-time inference is the recognition and exploitation of the fact that the parameter-to-observable (p2o) map is governed by an *autonomous dynamical system*, which takes the seafloor velocity (parameter field) as input, solves the acoustic-gravity wave equations, and extracts the pressures (observables) at the sensor locations and observation times. Specifically, the acoustic-gravity model represents a linear, time-invariant dynamical system for which we can write the discrete p2o map as a *block lower triangular Toeplitz matrix* that corresponds to a *time-shift invariance* of its blocks. This invariance implies that (i) we can precompute the p2o map from only as many adjoint PDE solutions as the number of sensors; (ii) we can embed the block Toeplitz matrix within a block circulant matrix that is block-diagonalized by the discrete Fourier transform; and (iii) the p2o matvec becomes a block-diagonal matvec operation in Fourier space.

Scalability is critical for the most expensive part of the offline computations: the adjoint PDE solutions. We discretized these adjoint wave propagation problems with the MFEM finite element library[1][1]. Next, we ran MFEM-based GPU simulations on large computer systems, including Lawrence Livermore National Laboratory's *El Capitan* — the highest-ranked supercomputer on the Top500 list.[2] Here, the MFEM solver demonstrated excellent scalability with up to 43,520 GPUs. The biggest problem involved more than 55.5 trillion degrees of freedom, which appears to be the largest reported unstructured mesh finite element computation.

We applied our digital twin framework to the Cascadia Subduction Zone (CSZ), which stretches 1,000 kilometers from northern California to British Columbia (see Figure 1, on page 1). Because its last catastrophic seismic event was 300 years ago, seismologists consider the CSZ to be overdue for a magnitude 8.0-9.0 megathrust earthquake; paleoseismic and geodetic evidence indicates a recurrence interval of roughly 250 to 500 years. To assess our framework's feasibility for near-field, real-time tsunami forecasting, we generated realistic seafloor displacements that capture the nonlinear interaction of seismic wave propagation and frictional rock failure during a magnitude 8.7 CSZ dynamic rupture scenario that we computed with the earthquake simulation code SeisSol[3] [3]. We then used these "true" seafloor displacements as a source for our tsunami model to generate synthetic observational data with added noise at 600 different hypothesized seafloor pressure sensors. The sparse, noisy observations of acoustic pressure allowed us to solve the PDE-based inverse problem for the spatiotemporal parameter field with more than one billion parameters—which represent seafloor velocities during the earthquake—and make predictions of the QoI (sea surface wave height) at 21 forecast locations.

The offline phase, which we performed just once, required 621 adjoint wave propagations and took 538 hours on 512 GPUs. Given real-time data, the online phase requires just 0.2 seconds to exactly solve the billion-parameter inverse problem. Figures 2 and 3 illustrate the results of the parameter inference and QoI prediction under uncertainty.

Given a sufficient number of ocean bottom sensors, this work ultimately enables real-time probabilistic tsunami forecasts for near-field events where conventional systems may fail due to delayed or inaccurate source characterization, such as a future magnitude 8.0–9.0 CSZ megathrust earthquake. Our digital twin framework accounts for complex rupture dynamics and tsunami wavefields in real time, under uncertainty, and without sacrificing the predictive power of the full three-dimensional wave propagation equations. This structure enables early predictions of inundation and evacuation zones within seconds, which is critical for life-saving responses where warning time is otherwise measured in minutes.

Autonomous dynamical systems arise in many different settings beyond geophysical inversion. Our Bayesian inversion-based digital twin framework is more broadly applicable to acoustic, electromagnetic, and elastic inverse scattering; source inversion for the transport of atmospheric or subsurface hazardous agents; satellite inference of emissions; and treaty verification, among other settings.

This article is based on Omar Ghattas' Ivo & Renata Babuška Prize lecture[4] at the 2025 SIAM Conference on Computational Science and Engineering,[5] which took place last year in Fort Worth, Texas. The corresponding paper [4] was awarded the Association for Computing Machinery's Gordon Bell Prize[6] at the 2025 International Conference for High Performance Computing, Networking, Storage, and Analysis (SC25), which was held in St. Louis, Mo., last November.

Acknowledgments: This research was supported by U.S. Department of Energy (DOE) Advanced Scientific Computing Research grant DE-SC0023171; U.S. Department of Defense Multidisciplinary University Research Initiatives grants FA9550-21-1-0084 and FA9550-24-1-0327; U.S. National Science Foundation grants DGE-2137420, EAR-2225286, EAR-2121568, OAC-2139536, and RISE-2425922; and European Union 2020 Horizon grants 101093038, 101058518, and 101058129. Work was performed under the auspices of the DOE by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344 (LLNL-PROC-2004753). This research utilized resources from the Swiss National Supercomputing Centre, the Texas Advanced Computing Center, the National Energy Research Scientific Computing Center (ALCC-ERCAP0030671), and Livermore Computing.

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[1] https://mfem.org
[2] https://top500.org
[3] https://seissol.org
[4] https://www.siam.org/programs-initiatives/prizes-awards/major-prizes-lectures/ivo-renata-babuska-prize
[5] https://www.siam.org/conferences-events/past-event-archive/cse25
[6] https://awards.acm.org/bell

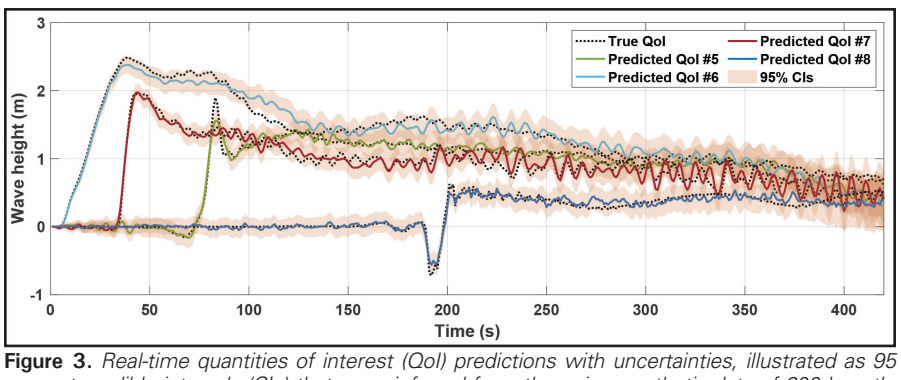

Figure 3. *Real-time quantities of interest (QoI) predictions with uncertainties, illustrated as 95 percent credible intervals (CIs) that were inferred from the noisy, synthetic data of 600 hypothesized seafloor acoustic pressure sensors for a margin-wide rupture in the Cascadia Subduction Zone. The QoI numbers in the upper right corner refer to a subset of the 21 QoI forecast locations in the inferred (reconstructed) sea surface wave height plot in Figure 2f. Figure courtesy of [4].*

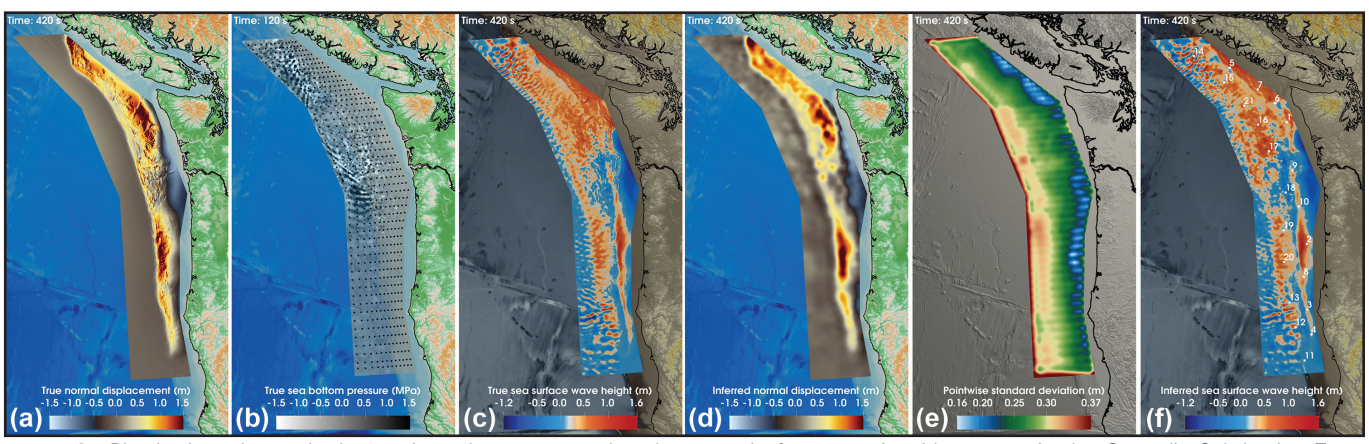

Figure 2. *Physics-based magnitude 8.7 dynamic rupture earthquake scenario for a margin-wide rupture in the Cascadia Subduction Zone.* **2a.** *True seafloor displacement field.* **2b.** *Snapshot of true seafloor acoustic pressure field with 600 hypothesized sensor locations.* **2c.** *Snapshot of true sea surface wave height.* **2d.** *Inferred mean of seafloor displacement.* **2e.** *Uncertainties that are plotted as pointwise standard deviations in meters of seafloor normal displacement.* **2f.** *Snapshot of reconstructed sea surface wave height with 21 locations for quantities of interest predictions. See the online version of this article for animations of the source (seafloor vertical uplift and normal velocity), forward solution (sea bottom pressure and surface wave height), and inverse solution (true and inferred seafloor normal displacement). Figure courtesy of [4].*

Newest Leadership

Continued from page 2

The ongoing dedication and commitment of SIAM's leadership contribute to the enduring success and forward motion of the Society, and SIAM is deeply appreciative of the entire slate of candidates and the members who voted in the most recent election. Thank you for your continued willingness to serve our community!

Lina Sorg is the managing editor of SIAM News.

City Growth

Continued from page 1

data is denser at higher latitudes because of Landsat's orbital trajectory.

Dividing and Scaling

Based on the extensive WSF dataset, Barthelemy and his colleagues selected 19 cities that grew more or less radially outward without too many irregularities. They included Paris, France; Kolkata, India; Beijing, China; and Las Vegas, Nev. (see Figure 1)—which are expanding in a predominantly concentric manner—but not Los Angeles, Calif., whose growth is constrained by the Pacific Ocean on one side and mountains on the others. This self-imposed restriction allowed the researchers to address limited anisotropies but avoid the type of strongly directional growth that occurs due to mountains or water.

The team used the city clustering algorithm to identify the largest connected component (LCC), i.e., the city core. To measure growth and roughness, they divided each LCC into segments and calculated the average extent of the city from its geometrical center. Angular width is exactly the city size in a system with perfectly isotropic growth, but modeling expansion with rough—or even fractal—edges requires tinkering with the size of the segments. "If [segments] are too small, you are averaging over the size of two or three houses, for example," Barthelemy said. "And [they can't be] too large because then you average too much and you don't see anything."

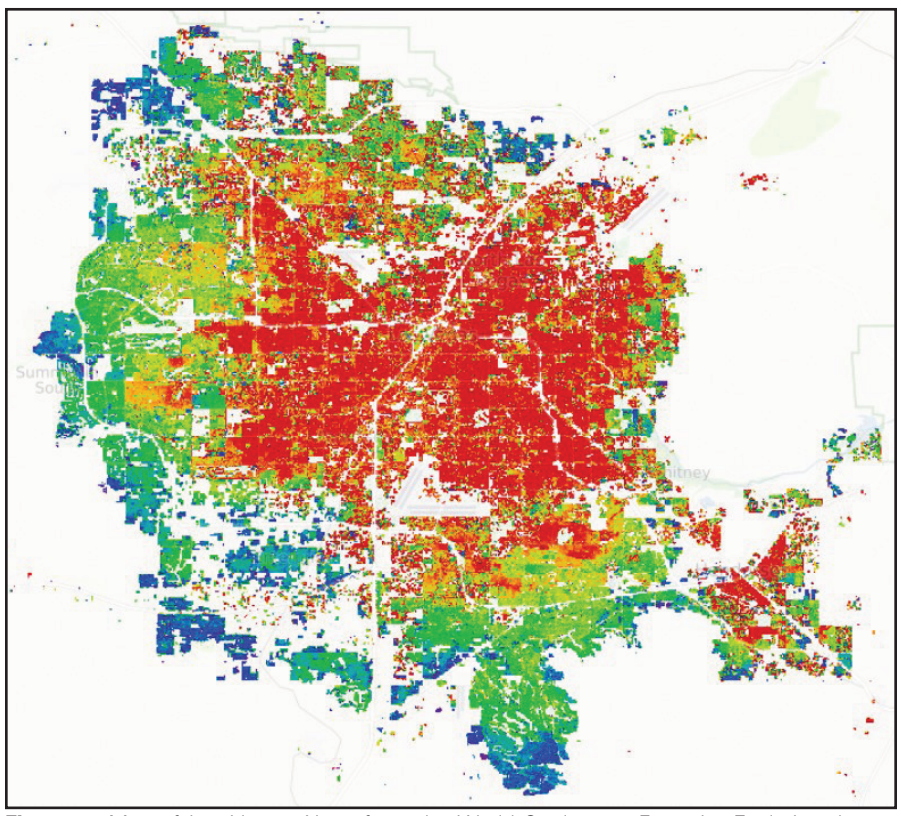

Figure 1. *Map of Las Vegas, Nev., from the World Settlement Footprint Evolution dataset that depicts physical growth from 1985 to 2015. The colors indicate the years in which the data were collected. Figure courtesy of OpenStreetMap/German Aerospace Center/Earth Observation Center/NASA/U.S. Geological Survey.*

The group settled on segment sizes of angular width $\Delta\theta = 2\pi/N$, where $N \approx 50$ to keep each segment within those limits. Without a continuous time variable, they used population P as a proxy time measure and defined the city "width"—effectively flattening two dimensions into one for comparison with other studies—via an estimate from anisotropic growth research:

$$w(\ell, P) \approx P^{\beta}\left(\frac{\ell}{P^{1/z}}\right)^{\alpha_{\text{loc}}}.$$

Here, $\ell = \langle r \rangle \Delta\theta$ is the average arc length for each segment. The scaling exponents describe the rapidity at which roughness develops (β); the rate at which roughness saturates (z); and the local roughness coefficient α_{loc}, which is the key number in this study. Plotting city size against arc length for each population data point produces a curve that can estimate the exponents and (with some luck) reveal universal mathematical laws for city growth.

Unfortunately, luck is not always at hand. A 1D system only has one global roughness measure $\alpha = \beta z$, and previous efforts identified distinct patterns in these numbers. However, Barthelemy's team found $\alpha_{\text{loc}} = 0.776 \pm 0.475$ for the 19 cities in their sample. Additionally, α ranged between 0 and 2, where most values were larger than α_{loc} and had no discernible pattern. In other words, *local* roughness appears to be a common factor between these diverse city samples, but global roughness and universality categories from 1D models do not match up with the data.

What Rough City

Since many of the cities in question have existed for centuries in some form—and most experienced rapid expansion well before 1985—any general conclusions are strictly provisional. "I wish I had remote sensing data over three or four centuries," Barthelemy said with a laugh. Despite this limitation, he argues that the local roughness exponent is robust and reproducible; if new or better data become available, others can test the hypothesis.

"I trust the value of the exponent, which seems to characterize the geometry of the boundary in some sense," Barthelemy said. "It's unclear at what point [every city] could be described by one equation, but I think that if you add more cities, et cetera, it'll just reinforce the message that we don't have universality." Simply put, city growth does not correspond to any existing universality classes, but there are still some quantitative properties that are available for extraction. The fact that the roughness exponent is the same for Las Vegas, Paris, and Changzhou, China—cities that could not be more different in most respects—indicates the presence of something that cannot be explained with 1D models.

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[2] Marquis, U., Artime, O., Gallotti, R., & Barthelemy, M. (2025). Universal roughness and the dynamics of urban expansion. *Phys. Rev. Lett., 135*(18), 187403.

[3] Rozenfeld, H.D., Rybski, D., Andrade Jr., J.S., Batty, M., Stanley, H.E., & Makse, H.A. (2008). Laws of population growth. *Proc. Natl. Acad. Sci., 105*(48), 18702-18707.

Matthew R. Francis is a physicist, science writer, public speaker, educator, and frequent wearer of jaunty hats. His website is https://bowlerhatscience.org.

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INTERNATIONAL MATHEMATICAL UNION IMU

Introducing the 2025-2026 SIAM Project NExT Fellows

By Lea Jenkins, Matt Dallas, and Rafael Ceja Ayala

SIAM routinely supports the professional development of junior faculty members and recent Ph.D. graduates in multiple ways. For example, the SIAM Activity Group on Applied Mathematics Education[1] furthers the advancement of educational programs, courses, and resources in applied math to better serve its academic members. SIAM also promotes the occupational growth of early-career scientists through its annual sponsorship of two Mathematical Association of America[2] (MAA) Project NExT (New Experiences in Teaching) Fellows. The Society is proud to announce that Matt Dallas of the University of Dallas and Rafael Ceja Ayala of Arizona State University (ASU) have been selected as the 2025-2026 SIAM Project NExT Fellows. Congratulations to these accomplished early-career mathematicians!

Matt Dallas of the University of Dallas.

Project NExT[3] is a professional development program of the MAA for new or recent Ph.D.s in the mathematical sciences that "addresses all aspects of an academic career: improving the teaching and learning of mathematics, engaging in research and scholarship, finding exciting and interesting service opportunities, and participating in professional activities."

The yearlong program aims to provide junior faculty in postsecondary environments with workshop access, opportunities to build a peer network, and connections with mentors who can share valuable career guidance. Project NExT Fellows ultimately learn better strategies for engaging and supporting a wide range of students, involving students in mathematics research projects, preparing future teachers for the K-12 mathematics classroom, and balancing teaching and research obligations at academic institutions.

To facilitate this evolutionary journey, SIAM offers multiple opportunities for its Fellows to participate in SIAM activities and expand their professional networks. Previous SIAM Project NExT Fellows have served on the SIAM Education Committee,[4] organized SIAM-sponsored sessions at the Joint Mathematics Meetings[5] (JMM) and MAA Mathfest,[6] helped to plan and execute "Student Days" events at the SIAM Annual Meeting, developed and managed SIAM outreach events, and organized minisymposia and panels at SIAM conferences.

Rafael Ceja Ayala of Arizona State University.

SIAM 2025-2026 Project NExT Fellow Matt Dallas is a postdoctoral instructor of mathematics in the Department of Mathematics at the University of Dallas. He received his Ph.D. in mathematics from the University of Florida in 2024, and his research interests are in numerical analysis — with a particular focus on nonlinear solvers and Anderson acceleration extrapolation schemes. Dallas' recent work considers novel applications for problems in fluid mechanics and the development of Anderson acceleration theory in the context of a broad class of solvers, including the well-known Levenberg-Marquardt method.

Beyond his personal research pursuits, Dallas is passionate about teaching and strives to create positive, interactive mathematical experiences for his students. At the University of Dallas, he has guided student projects on novel applications of Anderson acceleration and has been experimenting with inquiry-based learning, alternative assessment, and teaching with primary historical sources; he even contributed to a study about student experiences with these sources. Dallas also co-organized a session at JMM 2026, which took place in January in Washington, D.C., on "Perspectives on Implementing Alternative Grading" with members of his Project NExT cohort.

In August 2026, Dallas will join the Department of Mathematics at Transylvania University as an assistant professor. He is excited to further develop his research, mentor undergraduate projects in numerical analysis, and continue his work with alternative assessment and active learning practices. Besides math, Dallas enjoys reading, backpacking—particularly on the Appalachian Trail—visiting national parks, and spending time with his family.

Rafael Ceja Ayala, the other 2025-2026 SIAM Project NExT Fellow, is a Presidential Postdoctoral Fellow in the School of Mathematical and Statistical Sciences at ASU. He earned his Ph.D. in

See **Project NExT** *on page 7*

[1] https://www.siam.org/get-involved/connect-with-a-community/activity-groups/applied-mathematics-education

[2] https://maa.org

[3] https://maa.org/maa-project-next

[4] https://www.siam.org/get-involved/connect-with-a-community/committees/education-committee

[5] https://www.jointmathematicsmeetings.org/jmm

[6] https://maa.org/event/mathfest

Frontiers in Multidimensional Pattern Formation: Recapping the 2025 Gene Golub SIAM Summer School

By Jason Bramburger, Ryan Goh, and Priya Subramanian

The warm, dry days of late summer in Montréal, Québec, Canada, set the scene for the 2025 Gene Golub SIAM Summer School[1] (G2S3), which took place in August at Concordia University. This year's school centered on "Frontiers in Multidimensional Pattern Formation,"[2] and an engaging program brought together 41 Ph.D. students and postdoctoral researchers from around the world. During two intensive weeks of coursework, participants attended lectures on a wide range of topics, including functional analysis, stability theory, scientific computing, computational algebraic geometry, and computer-assisted proofs. The program thus equipped students with a multitude of information while simultaneously providing practical experience as they formed teams to work on joint research problems, which they presented on the final day.

During the first week, four lectures and two hands-on tutorial sessions familiarized attendees with the concepts of existence, stability, and numerical continuation. The opening talk offered an introduction to analytical techniques that prove the existence and stability of patterned solutions to partial differential equations (PDEs). Gabriela Jaramillo of the University of Houston spoke about the Lyapunov-Schmidt reduction, center manifold theory, and the method of multiple scales to prove the existence of patterns. Björn de Rijk of Karlsruhe Institute of Technology in Germany, who led the stability portion of the series, then focused on spectral theory of differential operators, exponential dichotomies, and Floquet-Bloch decompositions. David Lloyd of the University of Surrey in England complemented these analyses with an overview of numerical continuation techniques and demonstrations that allowed participants to obtain branches of solutions—such as spatially-extended periodic patterns, fronts, and localized solutions—in the prototypical pattern-forming Swift-Hohenberg equation.

Throughout the accompanying tutorials, students worked in small groups to collectively solve one or two problems from a provided list. These interactions inspired lively dialogues as teams applied new concepts—often from same-day lectures—to their tasks. Each group chose a representative to present their solution, which permitted the entire cohort to engage with and talk about the problems at hand.

In addition to structured learning sessions, that initial week included dedicated lunch time for mentoring conversations, a social event at a local pub, and a panel discussion about open problems. During the panel, speakers provided their "wish lists" of open problems on three different timetables: those that might be approachable in one to two years, roughly five years, and 10 or more years. Topics included (i) two-dimensional (2D) extensions of operators with desired Fredholm properties; (ii) spectral stability of large amplitude patterns and marginal stability conjecture for pattern selection; (iii) proof of existence for 2D localized hexagons that emerge from Turing bifurcations; (iv) explanations of defects as pattern-to-pattern fronts, starting in one dimension and extending to penta-hepta defects in the 2D Swift-Hohenberg equation; (v) pattern formation on random networks; (vi) spatiotemporal patterns in data; (vii) the determination of center manifolds for nonstationary, spatially-localized patterns; (viii) heterogeneities and boundaries in pattern selection; and (ix) geometric singular perturbation theory for infinite-dimensional systems.

After a restful weekend, the second week of G2S3 explored promising new directions in the study of multidimensional patterns. The curriculum sought to highlight two innovative approaches—computational

See **SIAM Summer School** *on page 8*

[1] https://www.siam.org/programs-initiatives/programs/gene-golub-siam-summer-school

[2] https://sites.google.com/bu.edu/2025-siam g2s3

Students and lecturers gather for a group photo during the 2025 Gene Golub SIAM Summer School, which took place in August in Montréal, Québec, Canada. The theme of this year's program was "Frontiers in Multidimensional Pattern Formation." Photo courtesy of Priya Subramanian.

SIAM Publications: Ensuring Trust, Quality, and Accessibility

By Kivmars Bowling

Before I dive into the many exciting developments for SIAM Publications over the last year, I want to begin by acknowledging the passing of Howard Elman, SIAM's former Vice President for Publications, in September 2025 after a long battle with illness.

Remembering Howard Elman

Howard was a highly accomplished, dedicated, and respected member of the SIAM community who had an invaluable impact on the SIAM Publications program. He served on the Editorial Board of the *SIAM Journal on Scientific Computing*[1] for more than 25 years and was editor-in-chief for six of those years. He was also a member of the SIAM Journal Committee[2] before becoming Vice President for Publications in 2020 — a tumultuous time to assume such an important role. But more than all of that, Howard was a great person who was always thoughtful, kind, and collegial in his approach to any topic. The SIAM Publications team and I will miss him a great deal, and we send our condolences to his family, friends, and colleagues. A recent obituary in *SIAM News* details his life and legacy [2].

I would also like to thank Tamara Kolda of MathSci.ai for stepping up as interim Vice President for Publications last year, and we are delighted that she is officially succeeding Howard in 2026. Tammy first met Howard when she was a graduate student—in fact, he appointed her to her first editor position—so it is fitting that she will build upon his work in this role.

Record Submissions and Readership for SIAM Journals

2025 was another strong year for the highly respected SIAM Journals program, with record levels in author submissions and readership. Journal article downloads have increased by roughly 80 percent since 2020, and an article is now downloaded once every 19 seconds.

As always, I ask you, your colleagues, and your students to access SIAM journals *from within your campus IP range or institutional VPN whenever possible*. Doing so ensures that librarians see that SIAM journals are being read, which prompts them to renew institutional subscriptions. Every download of a SIAM article is a vote for your library to retain the corresponding SIAM journal. If you don't have institutional access to a particular SIAM journal, please contact your librarian and make the recommendation; alternatively, feel free to reach out to SIAM at **service@siam.org.**

Editor-in-chief Transitions for SIAM Journals

2026 will see editor-in-chief (EIC) transitions for three SIAM journals: *Multiscale Modeling and Simulation*[3] (*MMS*), the *SIAM Journal on Mathematics of Data Science*[4] (*SIMODS*), and the *SIAM Journal on Optimization*[5] (*SIOPT*) (see Figure 1). We sincerely thank all of the outgoing EICs for their work and dedication and welcome their successors.

Submit to the *SIAM Journal on Life Sciences*

We were delighted to see the new *SIAM Journal on Life Sciences*[6] (*SIALS*) open for submissions in July 2025, with the first articles expected to publish in early 2026 (see Figure 2). Jonathan Rubin of the University of Pittsburgh is the founding editor-in-chief, while Simone Bianco of Altos Labs is serving as a founding section editor. Rubin and Bianco proposed the journal to the SIAM Board of Trustees in 2024 after a successful "Special Section on the Life Sciences"[7] in the *SIAM Journal on Applied Mathematics*.[8]

SIALS will publish research on the substantive use of quantitative methods to study biological systems and their applications. Submissions should involve novel mathematical models of biological systems, the development and application of new quantitative methodologies, and/or the use of existing mathematical methodologies for the analysis of biological models. All articles must include a clear connection to life sciences issues with biological, medical, or industrial relevance.

The launch of *SIALS* marks a milestone for an idea that has circulated within the SIAM community for more than two decades. SIAM has had a thriving conference and Activity Group on Life Sciences[9] for many years, and now the SIAM Journals program offers a dedicated home and voice for research in this growing field.

Joint Math Society Author Guidelines on Accessibility

SIAM continues to work with our publications platform and production vendors to ensure compliance with the Web Content Accessibility Guidelines 2.2,[10] which surpass the standard need for compliance with the European Accessibility Act[11] as well as updated U.S. mandates under Title II of the Americans with Disabilities Act[12] and Section 508 of the Rehabilitation Act.[13]

In early 2025, SIAM brought together the American Mathematical Society, European Mathematical Society, and London Mathematical Society to jointly create *Author Guidelines for Preparing Accessible Mathematics Content*.[14] These guidelines will (i) assist authors so that their content allows for conversion to a range of accessible formats and (ii) ensure that math societies and publishers ask authors to follow the same protocols when creating content, e.g., writing alt text for every figure.

Each society is publishing their own version of the guidelines that are tailored to their specific processes (SIAM's version is available online[15]), but the core tenets will remain the same. The guidelines will undoubtedly be refined over time, and we encourage members of the SIAM community to send any feedback to **publicationsaccessibility@siam.org**. They will be shared widely with other mathematics publishers as well as publishing industry accessibility groups, and I presented the project at several library conferences in 2025 and the 2026 Joint Mathematics Meetings.[16]

While the *Author Guidelines for Preparing Accessible Mathematics Content* will help with newly published material, making the archives accessible will be a significant, long-term project in terms of time and cost. In the meantime, if a student or researcher needs an accessible version of a specific item, they (or their librarian) can contact SIAM at the aforementioned email address and we will work to provide accessible text within a reasonable period of time, depending on the complexity and feasibility of the archived content. An Accessibility Statement for the SIAM Publications Library is available online.[17]

SIAM to Publish ICM and ICIAM Proceedings

The SIAM Proceedings collection[18] continues to grow with the inclusion of prestigious new series. In September 2025, the Board of the International Council for Industrial and Applied Mathematics (ICIAM) selected SIAM to publish the *ICIAM Proceedings* book series, starting with the proceedings of the 2027 International Congress on Industrial and Applied Mathematics[19]—set to take place in the Hague, the Netherlands—and continuing with future congresses.

In addition, SIAM is preparing to publish the 2026[20] International Congress of Mathematicians (ICM) proceedings. ICM 2026 will be held from July 23 to 30 in Philadelphia, Pa. SIAM secured both the ICIAM and ICM proceedings after competitive request-for-proposal processes, and we are delighted to serve as their trusted partner.

In December 2025, SIAM also published the proceedings from the esteemed 2025 New York Scientific Data Summit,[21] which was organized by Brookhaven National Laboratory and took place in September. I encourage members of the SIAM community to contact me at **bowling@siam.org** if they know of other high-quality proceedings that SIAM should consider publishing.

Call for Book Proposals and Author Testimonials

One of the most unique things about SIAM Publications is our authors' appreciation of their experiences with our team, particularly compared to commercial publishers. It is not hyperbolic to say that SIAM offers an industry-leading level of copyediting, along with personal care and attention in our author interactions.

The following is a selection of lovely, unsolicited comments that SIAM book authors have sent:

- "Steve [Weinstein] and I just got our books, and they are breathtaking! Everything I would expect from having SIAM books during my academic career. Thank you so much for making this happen!" – *Nathaniel Barlow*
- "I wish to sincerely thank you, and more generally SIAM, for the quality of your cooperation with authors and of the books that you actually publish. When I discuss with some colleagues who are publishing books with other publishers, they all envy me!" – *Philippe Ciarlet*
- "I appreciate your professional and punctual handling of the manuscript, it was the best publication experience I've had." – *George Haller*
- "What a pleasure it is to work with SIAM!" – *Michael Overton*

If you have an idea for a book, please contact Elizabeth Greenspan (Executive Editor of SIAM Books) at **greenspan@siam.org**. SIAM publishes high-quality monographs and textbooks and is also seeking proposals for more general interest books.

Increasing Levels of AI Use

Readers of my last annual update will recall my comments that generative artificial intelligence (AI) is expected to impact scholarly publishing in both positive and negative ways [1]. SIAM's Editorial Policy on Artificial Intelligence,[22] which has been in place since October 2023, stipulates the way in which authors and reviewers can utilize AI and large language models (LLMs). Over the last year, authors have disclosed the use of AI in their articles, but we have also seen some suspected undisclosed usage in a few submissions and reviews. As models continue to improve and eradicate hallucinations that may serve as easy detection signals, the risk increases that editors may receive plausible-sounding submissions that are actually partially or wholly fraudulent and AI-generated.

On the flip side, however, AI models are also beginning to offer powerful new capabilities for authors who wish to check the validity and accuracy of their work. Such competencies may be promising as long as they are used in a responsible and

See **SIAM Publications** *on page 7*

Figure 2. *The new SIAM Journal on Life Sciences is currently accepting submissions and expects to publish its first batch of articles in early 2026. SIAM image.*

Publication	Outgoing Editor-in-chief	Incoming Editor-in-chief
MMS	Liliana Borcea (Columbia University)	Lorenzo Pareschi (Heriot-Watt University and University of Ferrara)
SIMODS	Mikhail Belkin (University of California, San Diego)	David Gleich (Purdue University)
SIOPT	Jong-Shi Pang (University of Southern California)	Radu Ioan Boţ (University of Vienna)

Figure 1. *The outgoing and incoming editors-in-chief for Multiscale Modeling and Simulation (MMS), the SIAM Journal on Mathematics of Data Science (SIMODS), and the SIAM Journal on Optimization (SIOPT). Figure courtesy of the author.*

[1] https://www.siam.org/publications/siam-journals/siam-journal-on-scientific-computing
[2] https://www.siam.org/get-involved/connect-with-a-community/committees/journal-committee
[3] https://www.siam.org/publications/siam-journals/multiscale-modeling-and-simulation-a-siam-interdisciplinary-journal
[4] https://www.siam.org/publications/siam-journals/siam-journal-on-mathematics-of-data-science
[5] https://www.siam.org/publications/siam-journals/siam-journal-on-optimization
[6] https://www.siam.org/publications/siam-journals/siam-journal-on-life-sciences
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[22] https://epubs.siam.org/artificial-intelligence

Project NExT

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applied mathematics at Purdue University, where his doctoral research explored inverse scattering problems with conductive boundaries — a topic that he continues to investigate at ASU. Ceja Ayala studies direct and inverse problems for partial differential equations, and his work connects deep mathematical theory with real-world applications in imaging, nondestructive testing, and the detection of hidden structures in complex materials. He develops rigorous yet computationally efficient methods for inverse scattering and electrical impedance tomography and contributes to the growing theory of transmission eigenvalues: wavenumbers that offer insight into the movement of waves through different media.

Throughout his early career, Ceja Ayala has been an active and involved member of the applied mathematics community. He has presented at major SIAM conferences, organized several minisymposia, participated in and wrote about a 2024 workshop on "Empowering a Diverse Computational Mathematics Research Community"[7] (hosted by the Institute for Computational and Experimental Research in Mathematics and run in collaboration with SIAM), and served as a Guided Affinity Group leader for the Sustainable Horizons Institute's Building Engagement program[8] at the 2025 SIAM Conference on Computational Science and Engineering.[9] In 2025, Ceja Ayala received the MGB-SIAM Early Career Fellowship.[10]

Ceja Ayala is equally committed to mentorship and inclusion in mathematics education. At both Purdue and ASU, he taught a variety of courses, co-organized graduate seminars, and mentored students through honors theses, summer research opportunities, and national programs. He strives to create learning environments that emphasize curiosity, belonging, and creativity while showing students the myriad ways in which mathematics can illuminate the world around them. As Ceja Ayala continues his postdoctoral work at ASU, he remains dedicated to advancing research in inverse problems, building collaborative research networks, and supporting the next generation of mathematical scientists.

Outside of work, Ceja Ayala enjoys hiking, biking, running, and spending time outdoors. He is also passionate about photography and creative writing, which allow him to explore the world from different perspectives.

Junior SIAM members who are pursuing academic careers should consider applying for the Project NExT program. Interested parties must complete the application form and submit a personal statement, research statement, one-page curriculum vitae, and letter of support from their department chair. Eligible candidates should hold a recent Ph.D. in mathematics, statistics, mathematics education, or another math-intensive field; maintain a current teaching position; and have experiences, attitudes, ideas, and leadership abilities that would contribute to the cohort. To be considered for SIAM sponsorship, applicants must note their SIAM membership on their application. An MAA committee selects all Project NExT Fellows. Visit the Project NExT website[11] for additional details and apply before the next deadline of **April 15, 2026**.

Lea Jenkins is a professor in the School of Mathematical and Statistical Sciences at Clemson University, where she works on modeling and simulation problems with industrial applications. She holds a Ph.D. in mathematics from North Carolina State University and is the Vice President for Education at SIAM. Matt Dallas is a postdoctoral instructor in mathematics at the University of Dallas whose research interests include nonlinear solvers and their applications. He is also interested in active learning practices, teaching with primary historical sources, and alternative assessment. Dallas will join the Department of Mathematics at Transylvania University in August 2026. Rafael Ceja Ayala is a Presidential Postdoctoral Fellow in the School of Mathematical and Statistical Sciences at Arizona State University. His research interests include direct and inverse problems for partial differential equations, direct and inverse scattering, transmission eigenvalue problems, and qualitative reconstruction methods.

[7] https://www.siam.org/publications/siam-news/articles/icerm-siam-workshop-strengthens-the-computational-mathematics-research-community

[8] https://shinstitute.org/be-cse-2025

[9] https://www.siam.org/conferences-events/past-event-archive/cse25

[10] https://www.siam.org/programs-initiatives/programs/mgb-siam-early-career-fellowship

[11] https://maa.org/maa-project-next

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SIAM Publications

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ethical manner. SIAM is actively engaging in a number of conversations to explore the effective employment of LLMs in a safe, trusted, and transparent way while also proceeding cautiously to ensure the preservation of research integrity and standards. If you are involved in any such projects or have ideas about how AI should or should not be used in the context of research and publishing, feel free to contact me at **bowling@siam.org**.

Anthropic Class Action Settlement for Books

AI startup Anthropic was sued in August 2024 for its alleged use of pirated books to train its AI-based LLM model, Claude. The case resulted in a settlement of $1.5 billion USD[23] in relation to roughly 500,000 titles, which include several hundred SIAM books. SIAM has already contacted the affected authors and will guide them through the claims process with the settlement administrator.

I will note that this settlement is not because Anthropic allegedly used copyrighted books to train its AI, nor does it rule on whether doing so would fall under fair use; instead, it is a copyright infringement allegation of illegal book downloads. Other cases in the courts might soon rule on the legality of training an LLM with copyrighted material.

Thank You to SIAM Editors and Reviewers

Let me close by paying tribute to the excellent editorial work of our many editors and reviewers who uphold the incredibly high standards of SIAM publications. That trust in SIAM content—whether it be journals, books, or proceedings—will only become more vital as scholarly publishing and society at large battles against AI slop and questionable content.

As always, please reach out to me at **bowling@siam.org** if you have ideas, questions, or comments about the SIAM Publications program.

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[1] Bowling, K. (2025, January 21). SIAM publications: Safeguarding quality in a changing landscape. *SIAM News*, *58*(1), p. 5.

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The Multifaceted Benefits of Community Engagement in Industry and Academia

By Kathleen Kavanagh and Lea Jenkins

At the Third Joint SIAM/CAIMS Annual Meetings[1] (AN25), which took place last summer in Montréal, Québec, Canada, a minisymposium session titled "Community Engagement in Mathematics: What? Who? How?"[2] brought together applied mathematicians from a variety of fields to spotlight the growing movement toward outreach, collaboration, and public engagement in science, technology, engineering, and mathematics (STEM). The session, which was organized by the SIAM Education Committee,[3] highlighted diverse programs that connect professional mathematicians with students, educators, and industry partners — ultimately demonstrating that community engagement enriches both individual participants and the discipline as a whole.

In addition to more traditional research and teaching responsibilities, mathematicians play an important role in promoting enthusiasm and correspondence with the general public. For instance, heightened engagement in schools and local communities can spark student curiosity, broaden societal understanding of mathematics' critical contributions to real problems, and foster social responsibility. These types of initiatives strengthen ties between academia, industry, and society, ensuring that applied mathematics remains dynamic, relevant, and inclusive in the present day.

Kathleen Kavanagh of Clarkson University opened the AN25 session by discussing the surprising bridges between academia and industry that result from sustained community engagement. At Clarkson—a small, STEM-focused institution in rural New York—outreach programs for K-12 schools have become powerful platforms that build relationships with local businesses and research partners. By involving faculty, industry professionals, and school districts in collaborative projects, these efforts provide mutual benefits for all parties; students have the opportunity to witness the real-world applications of math, faculty form new research pathways, and local companies connect with the next generation of problem solvers — some of whom may become future employees.

Kavanagh, who serves as director of Clarkson's Institute for STEM Education,[4] also addressed practical challenges like funding and sustainability and offered strategies for getting started. Her talk underscored outreach's ability to drive mathematical innovation while simultaneously delivering broad social impact. One such example showcased the high schoolers of Harrisville Central School District: a small, rural district in New York with a typical graduating class size of only 15-20 students. Due to local university support, mentorship, and access to laboratory space, a team of dedicated students was able to take part in a prestigious national research challenge. The group's experiment was so successful that it was sent to the International Space Station, and participating students and their teacher traveled to Florida to view the launch of SpaceX CRS-26 in November 2022. The entire town celebrated this life-changing achievement, and two of the women on that team are now aerospace engineering majors.

Karen Bliss, then Senior Manager of Education and Outreach at SIAM, next introduced a mathematics program for middle school students, which resulted from a three-year experiment on a regional math modeling outreach day that quickly became a local tradition. Each year, seventh- and eighth-grade students from local schools are invited to Virginia Military Institute (where Bliss used to teach) to tackle open-ended math problems that require creativity, teamwork, and critical thinking. Bliss walked through the logistics of the program's creation—from the initial planning stages to final execution—and reflected on the overwhelmingly positive feedback from students and teachers alike. In fact, students often ask for more time to continue working on their assigned problem. At the end of the day, they share their solutions and leave with a richer understanding of math's copious problem-solving applications to complex, tangible issues — a distinction from many testing and classroom environments. Furthermore, the program's modest cost and adaptable structure should make it relatively easy to launch at other colleges and universities across the country; simply think of a modeling problem, identify some relevant math (e.g., data and equations), and let the students explore!

Bliss then overviewed the popular MathWorks Math Modeling Challenge[5] (M3 Challenge): a program of SIAM with MathWorks[6] as its title sponsor. Now in its 21st year, the annual internet-based competition engages thousands of 11th- and 12th-grade students across the U.S. and sixth form students in England and Wales. There are no registration fees, and participating teams of three to five individuals have 14

See **Community Engagement** *on page 10*

[1] https://www.siam.org/conferences-events/past-event-archive/an25

[2] https://meetings.siam.org/sess/dsp_programsess.cfm?SESSIONCODE=84944

[3] https://www.siam.org/get-involved/connect-with-a-community/committees/education-committee

[4] https://www.clarkson.edu/academics/research/labs-centers/stem-education

[5] https://m3challenge.siam.org

[6] https://www.mathworks.com

At the Third Joint SIAM/CAIMS Annual Meetings, which took place last summer in Montréal, Québec, Canada, Benjamin Galluzzo of the Consortium for Mathematics and Its Applications (COMAP) discusses two different COMAP middle and high school mathematical modeling contests during a minisymposium session that addressed the importance of community engagement in mathematics. SIAM photo.

SIAM Summer School

Continued from page 5

algebraic geometry and computer-assisted proofs—that build intradisciplinary bridges to emerging areas of applied mathematics with potential relevance to pattern formation. The lectures on computational algebraic geometry—delivered by silviana amethyst of the Max Planck Institute of Molecular Cell Biology and Genetics in Germany and Joseph Cummings of the University of Edinburgh in Scotland—began with the language of algebraic varieties and established the framework of numerical algebraic geometry, ultimately providing a working example in the form of a coral growth model. Jean-Philippe Lessard of McGill University in Canada and Matthieu Cadiot of École Polytechnique in France oversaw the course on computer-assisted proofs, which introduced ideas of interval arithmetic and finite-dimensional ordinary differential equations before tackling infinite-dimensional PDEs. Specific demonstrations highlighted recent efforts to prove the existence of localized stationary patterns in the Swift-Hohenberg equation in one and two spatial dimensions.

As in the first week, carefully designed tutorials complemented the lectures and stimulated dialogue among the entire cohort. At the end of the second week, the seven lecturers formed a panel to discuss open problems and future research directions. Some of the key conversation topics were as follows: (i) the analysis of dynamics of PDEs beyond equilibria, (ii) manifold calculations for PDEs, (iii) Cauchy problems for PDEs, (iv) the certification of singular solutions, (v) the extension of computer-assisted proofs to multidimensional patterns with multiple length scales, (vi) the application of such methods to prove the existence of solution branches or bifurcations, and (vii) their adaptation to handle nonlocal operators.

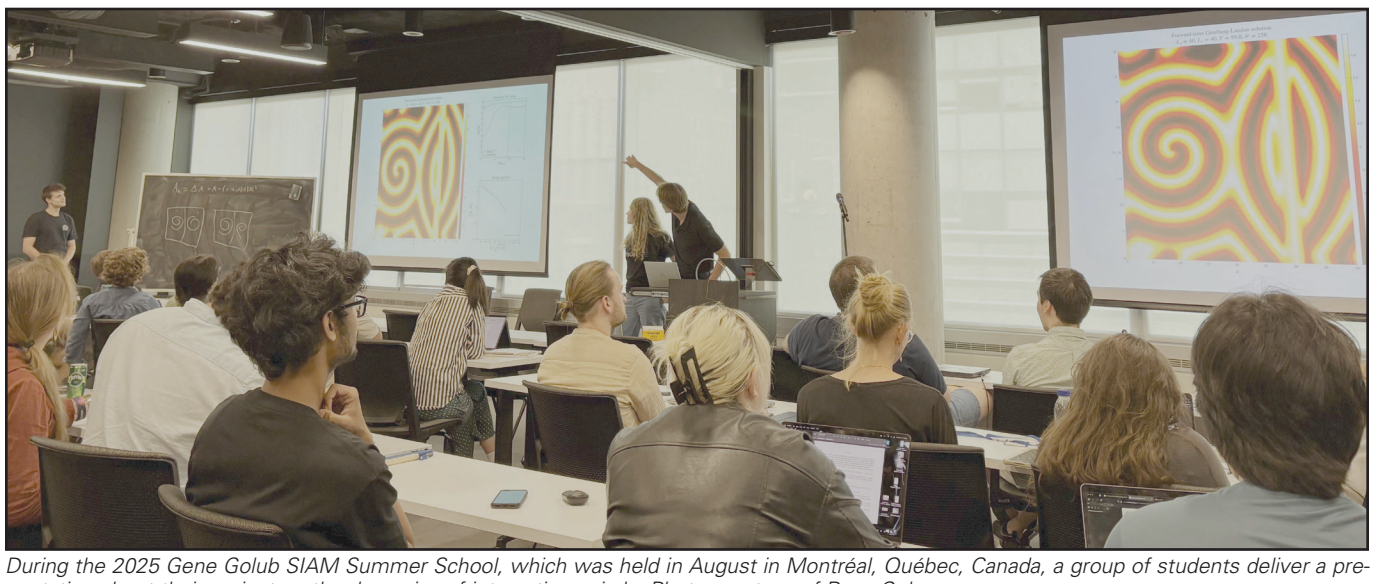
Afternoons in the latter half of the program were dedicated to group work, during which participants collaborated on their chosen projects and engaged in meaningful discourse with each other, lecturers, and organizers. The 2025 iteration of G2S3 culminated in group presentations and the collective sharing of progress and insights.

Overall, we are immensely proud of the participants' dedication and the high quality of their presentations, which showcased both their hard work and thorough comprehension of the material. We are confident that the summer school successfully summarized current challenges and state-of-the-art methods in the analysis and computation of multidimensional patterns, and we hope that it has inspired participants to utilize their newfound enthusiasm to achieve future breakthroughs in this exciting research area.

The 2026 Gene Golub SIAM Summer School on "Fault-tolerant Algorithms in Quantum Computing" will take place at Duke University in Durham, NC, from ***July 27 to August 7, 2026****. More information—including application instructions—is available on the G2S3 webpage.*[3] *Registration closes on* ***March 1****.*

Interested in organizing a future school? Letters of intent that propose topics and organizers for the 2027 iteration of G2S3[4] *are due to Richard Moore, SIAM's Director of Programs and Services, at* ***programs@siam.org*** *by* ***January 31****. Visit the G2S3 webpage to learn more.*

Jason Bramburger is an assistant professor of mathematics at Concordia University in Canada. His research focuses on dynamical systems in the context of pattern formation, wave propagation, spatiotemporal chaos, and data science. Bramburger is also a co-chair of the 2026 SIAM Conference on Nonlinear Waves and Coherent Structures, which will take place in May at Concordia. Ryan Goh is an assistant professor of mathematics at Boston University. His research explores mathematical approaches to pattern formation in nature, with applications that include vortices in rapidly-rotating fluids, embryogenesis, materials science, and chemical reactions. Priya Subramanian is a senior lecturer at the University of Auckland in New Zealand. She holds a Ph.D. in aerospace engineering, and her research seeks to identify minimal mechanisms that enable the emergence of multidimensional spatiotemporal patterns with desired properties across diverse physical systems.



During the 2025 Gene Golub SIAM Summer School, which was held in August in Montréal, Québec, Canada, a group of students deliver a presentation about their project on the dynamics of interacting spirals. Photo courtesy of Ryan Goh.

[3] https://www.siam.org/programs-initiatives/programs/gene-golub-siam-summer-school

[4] https://www.siam.org/publications/siam-news/articles/call-for-proposals-2027-gene-golub-siam-summer-school

Building Momentum: Why Membership Growth and Community Matter for SIAM Members

By Paula White

SIAM's 2025 membership story is one of resilience and renewal. After several years of decreased membership numbers due to global challenges and the COVID-19 pandemic, we are seeing steady progress toward pre-pandemic levels. Total SIAM membership rose to 14,190 at the end of last year—up from 12,275 in 2024—with 8,523 nonstudent members and 5,667 student members. These promising numbers represent more than simple growth; they reflect the strength of a community that continues to provide value, opportunity, and connection for those that it serves.

Why should this matter to you as a SIAM member? Membership growth directly impacts the quality and reach of the programs, resources, and networks on which you rely. A larger, more engaged community empowers richer scientific exchange at SIAM conferences,[1] stronger publications,[2] and more robust SIAM activity groups[3] (SIAGs) and sections.[4] Hearty membership numbers mean that when you attend a SIAM meeting, you will encounter a diverse range of perspectives and expertise. They ensure that SIAM can continue to offer travel awards,[5] host career fairs,[6] and promote leadership opportunities that allow students and early-career professionals to thrive. Finally, they solidify SIAM's position as a strong advocate for applied mathematics, computational science, and data science worldwide — something that benefits every member by elevating the visibility and influence of scientific fields.

Last year's growth was fueled by initiatives that sought to make membership more accessible and rewarding. For example, SIAM bundled membership with conference registration and offered free memberships to students[7] who participate in SIAM programs, which helped thousands of new individuals join our community. Paid student membership numbers surged to nearly 1,450, while free student membership grew to 4,250. SIAM also welcomed 17 new student chapters[8] and reactivated three others, bringing our global network total to 243 active chapters across 29 countries. These chapters are not just local clubs; they are gateways to collaboration, mentorship, leadership, and career development. Students who join SIAM gain access to specialized webinars, virtual and in-person career fairs, and opportunities to present research at SIAM conferences — experiences that often shape their academic and professional paths.

Regular membership—the backbone of SIAM—also showed encouraging signs of recovery, climbing to 5,888. Early-career membership remains an area of focus at 991 members, and SIAM is committed to supporting early-career researchers with targeted benefits. For instance, SIAM offers discounted membership rates for up to five years after graduation, routinely features junior scientists' work in *SIAM News* and SIAM News Online,[9] and has expanded its career resources through SIAM Engage:[10] an online networking platform that facilitates collaboration, event promotion, and professional exchange. These efforts ensure that members at every stage of their careers find value and opportunity within SIAM.

Overall community involvement likewise continues to grow. SIAG memberships rebounded to 14,626, and section membership has increased by more than 50 percent over the past five years. New sections in New England[11] and Northern and Central California[12] are thriving as regional hubs for members to share ideas, promote events, and connect with peers locally and internationally — making SIAM a *global* community.

Membership growth also allows SIAM to keep costs low for journals and conferences, invest in new initiatives, and provide valuable member benefits. For example, SIAM launched the *SIAM Journal on Life Sciences*[13] in 2025, which created novel publication and collaboration opportunities for individuals who work at the intersection of mathematics and biology. This journal reflects SIAM's commitment to support emerging areas of research and provide members with cutting-edge resources. Furthermore, a strong membership base ensures that the 2026 SIAM Annual Meeting[14] (AN26)—which will take place in Cleveland, Ohio, from July 6-10—can offer an even richer program of minisymposia, networking sessions, and career activities. AN26 and other SIAM gatherings are more than conferences; they are occasions to meet collaborators, discover new research directions, and build lasting relationships with peers and colleagues. This includes opportunities for SIAM students to network, present posters, attend career panels and sessions, and more through AN26 "Student Days" activities.

SIAM Student Member Coordinator Jurnee Jessie (left) and SIAM Membership Manager Paula White staff the membership booth at the 2025 SIAM Conference on Computational Science and Engineering, which took place last March in Fort Worth, Texas. SIAM photo.

When SIAM grows, every member wins. Growth means that more voices contribute to discussions about the future of applied mathematics, more people can serve as mentors and receive mentorship, and more pathways accelerate innovation. It also allows SIAM to continue to advocate for funding in applied mathematics, support initiatives that include members across all demographic segments, and provide resources that promote member success in academia, industry, and government.

Looking ahead, SIAM is preparing for an exciting 2026. In addition to AN26, members can anticipate expanded SIAG webinar series and additional opportunities to participate in global collaborations through SIAM Engage. SIAM will continue to invest in programs that support students and early-career professionals and help all members make the most of their SIAM experience.

Now that the new year is upon us, we invite you to assist us in sustaining this upward momentum. If you have not yet renewed, please do so today at **my.siam.org** and consider selecting the auto-renew option for uninterrupted access to benefits. Encourage recent graduates to join SIAM and take advantage of early-career discounts, and nominate current students for free membership[15] — each regular member can nominate two students per year. Most importantly, we urge you to stay connected: join a SIAG, post on SIAM Engage, attend a section meeting, or volunteer for a leadership position.[16] Every action strengthens our community and enhances the value of your membership.

Together, we can ensure that SIAM continues to thrive as a robust global network of applied mathematicians, computational scientists, and data scientists. If you have questions or ideas for engagement, please reach out to the membership team at **membership@siam.org**. Let's make 2026 a year of even greater growth and connection, both for SIAM and for every member who calls this community home.

Paula White is the Membership Manager at SIAM.

[1] https://www.siam.org/conferences-events
[2] https://www.siam.org/publications
[3] https://www.siam.org/get-involved/connect-with-a-community/activity-groups
[4] https://www.siam.org/get-involved/connect-with-a-community/sections
[5] https://www.siam.org/conferences-events/conference-support/travel-and-registration-support
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Overlooked History Revealed

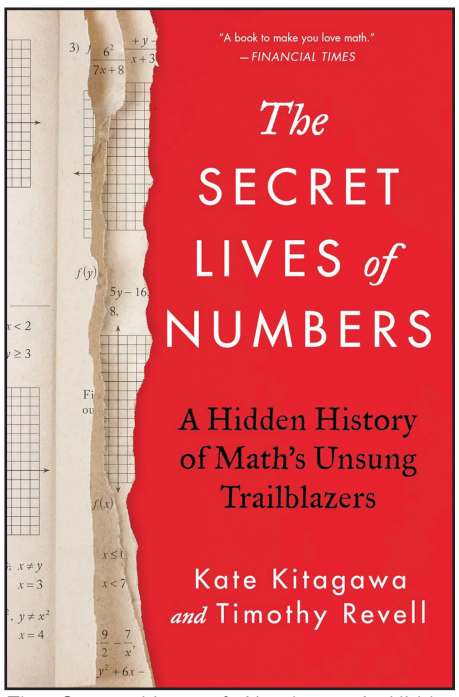
The Secret Lives of Numbers: A Hidden History of Math's Unsung Trailblazers. *By Kate Kitagawa and Timothy Revell. HarperCollins Publishers, New York, NY, July 2024. 320 pages, $32.99.*

BOOK REVIEW
By Paul Davis

Mathematicians know that projecting the surface of a sphere onto a plane is an error-prone undertaking. If that sphere is a map of the Earth, then the two-dimensional version can severely distort the relative sizes and proximities of nations and territories — warping the corresponding cultural perspectives that these geographic relationships suggest. In *The Secret Lives of Numbers: A Hidden History of Math's Unsung Trailblazers*, authors Kate Kitagawa and Timothy Revell offer a well-crafted historical survey that seeks to rectify geographic imbalances in perceptions of mathematical development while engaging readers in the evolution of mathematics as an iconic human achievement.

For mathematicians, the overall reading experience is akin to visiting a museum to view a retrospective of a beloved artist. Two skilled docents guide readers through little-known early works that presage the genius of well-known masterpieces or hint at revolutionary visions of familiar objects. My applied mathematician's eye could not help but notice that most early mathematical endeavors served the community needs of their time and culture in several ways, such as accurately recording and marking the extent of territory or guiding the planting of crops into propitious seasons. Abstraction and notions of proof emerged later as mathematical self-perception matured.

The painful stone in readers' shoes throughout this retrospective tour is the persistent gender, ethnic, and class biases in these preliminary mathematical establishments, which apparently reflected the cultural norms of the societies in which they were embedded. The most notorious example might be the treatment of Russian mathematician Sofia Kovalevskaya [1], whose career and reputation were plagued by demeaning gossip and sexual stereotypes — despite the prestige of her winning the French Academy of Science's *Prix Bordin* in 1888. Similarly, mathematics faculty at historically Black colleges and universities in the U.S., such as Howard University, have had to stand as breakwaters against relentless tides of racism that sought to exclude talented mathematicians of color from entering the profession.



The Secret Lives of Numbers: A Hidden History of Math's Unsung Trailblazers. By Kate Kitagawa and Timothy Revell. Courtesy of HarperCollins Publishers.

The scope of *The Secret Lives of Numbers* is wide, beginning 4,000 years ago with the legend of the Chinese emperor Yu the Great, who established the first Chinese imperial dynasty. While wading in the Yellow River, he is said to have received the alleged "Mandate of Heaven" by discovering a magic square[1]—a symbol of mathematical perfection—that was inscribed with Chinese numerals among the irregular markings on the back of a turtle. This auspicious pattern granted Yu the authority to present himself as rightful leader of the kingdom. As the authors note, "Mathematics in ancient China was power."

Some of the mathematical rituals that we take for granted in the present day seem to have manifested themselves in the ancient world. Whenever mathematicians in early societies would gather at local centers of excellence (to use modern vocabulary), scribes would laboriously record all that was known about important topics of the day. Plant leaves or clay tablets usually sufficed for what were essentially very early precursors to *SIAM Review* articles or lecture notes, like those published by the Conference Board of the Mathematical Sciences.[2] One such ancient "review article," inscribed on a clay tablet, reveals that mathematicians in the city of Babylon (about 100 kilometers south of modern-day Baghdad) were aware of the calculations behind the Pythagorean theorem long before Pythagoras and his colleagues were active in Greece. Another Babylonian tablet correctly approximated the square root of 2 to six decimal digits.

The Secret Lives of Numbers presents other accounts that trace the scientific similarities of ancient and modern society. In the eighth century CE, the Abbasid Caliphate—aided by prisoners from the Chinese army and their extensive knowledge of paper making—constructed the first-ever paper mill in Samarkand (now in Uzbekistan), which inspired an explosive accumulation and diffusion of knowledge that altered the trajectory of mathematics' intellectual development. Throughout the centuries, mathematical discovery continued apace across the globe in China, southern Asia, and the Maya civilization in Mesoamerica. Eventually, the book's storyline turns to Europe, Greece, and the U.K. Some of the more familiar accounts include charming vignettes of the interactions among G.H. Hardy, J.E. Littlewood, Srinivasa Ramanujan, and Mary Cartwright, including Cartwright's rise to the presidency of the London Mathematical Society.

Kitagawa and Revell's epilogue—which was no doubt written as the skies over American science were darkening but before the first thunderbolts struck—is relentlessly optimistic, extrapolating from the field's vibrant history to predict a sunny future for our discipline. U.S. mathematicians can only hope that history will repeat itself.

[1] A three-by-three grid of integers whose rows, columns, and diagonal sums are equal — the framework for the ubiquitous Sudoku puzzles.

[2] https://cbmsweb.org

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[1] Davis, E. (2022, April 1). Sofia Kovalevskaya: Mathematician and writer. *SIAM News, 55*(3), p. 7.

Paul Davis is a professor emeritus of mathematical sciences at Worcester Polytechnic Institute.

Community Engagement

Continued from page 8

consecutive hours to address a multifaceted mathematical modeling prompt and produce a 20-page report that justifies their findings. After a triple-blind judging process, the top finalist teams travel to New York City to present their solutions to a panel of judges and compete for more than $100,000 in scholarship funds.

Unlike many traditional math competitions, M3 Challenge prioritizes real-world problem solving, teamwork, and data analysis. Teachers benefit from free resources and professional development, while students gain exposure to applied mathematics in a wide variety of contexts — from sustainability to public health. Bliss explained that M3 Challenge helps to demystify applied math by positioning it as a creative, vital tool that encourages students to contemplate and tackle pressing global issues. The following comments from coaches demonstrate the contest's long-lasting takeaways and deviation from normal classroom-based mathematics education:

Please continue the M3 Challenge — our civilization needs this! Our kids are pressured excessively about grades, grades, grades, testing, testing, testing, standards, standards, standards, at the expense of intellectual curiosity and mathematical applications.

Challenge Weekend gives these youngsters an opportunity to experience working as a team for what is sometimes a stressful time period, and they learn a lot about themselves, perseverance, dealing with frustrations, and not being able to just look up the answer or ask a teacher. It is a wonderful opportunity!

Feedback from students provides further motivation for the continued development and implementation of these types of outreach programs:

I like that the prompts are centered around societal issues. It helps us understand/get a glimpse of what professionals must do to find solutions to the issues we face every day.

The whole concept of solving one problem as a group and the question itself were very engaging. It also recreates a job environment where we will have to communicate with other people to solve problems, which is certainly a valuable experience.

Despite being involved in many extracurriculars and academic competitions, M3 Challenge has easily been my favorite. The problems are exactly the types of questions I would love to ponder simply for their own sake, and I think [they] are actually designed extraordinarily well in the way they give just enough information to create a jumping off point, but not enough so as to restrict creative freedom.

One true advantage of M3 Challenge and the associated support system is its ability to showcase mathematics as an extracurricular activity, not just something to check off to earn a diploma. By providing a system where teachers and students can interact with math outside of the classroom environment, the contest changes the dynamic of the discipline at a critical stage for budding mathematicians. In fact, many participants go on to study mathematics or related STEM fields in college.

To close out the AN25 session, Benjamin Galluzzo of the Consortium for Mathematics and Its Applications[7] (COMAP) spoke about COMAP's efforts to engage students of all ages in mathematical modeling. COMAP hosts several major contests, including the High School Mathematical Contest in Modeling (HiMCM) and Middle Mathematical Contest in Modeling (MidMCM).[8] These international events challenge teams of three or four students to devise mathematical models for open-ended questions. Galluzzo noted that the real growth comes not just from the competition itself, but through mentorship, structured preparation, and post-contest reflection. By working with teachers, mentors, and community partners, students build confidence, hone their communication skills, and exhibit resilience — key attributes that extend well beyond mathematics.

At the end of the session, the presenters affirmed that the pathways towards community engagement are numerous and accessible. They reminded the audience that such efforts cultivate future problem solvers while strengthening the discipline's connections to society at large. SIAM plays a significant role in supporting these efforts through initiatives like M3 Challenge, *SIAM Undergraduate Research Online*,[9] virtual and in-person career fairs,[10] and numerous early-career programs for our members at conferences and via webinars. We encourage you to get involved by joining the SIAM Activity Group on Applied Mathematics Education[11] or otherwise volunteering your time to support the next generation of applied mathematicians.

Kathleen Kavanagh is a professor of mathematics at Clarkson University. Lea Jenkins is a professor in the School of Mathematical and Statistical Sciences at Clemson University, where she works on modeling and simulation problems with industrial applications. She holds a Ph.D. in mathematics from North Carolina State University and is the Vice President for Education at SIAM.

[7] https://www.comap.com

[8] https://www.comap.com/contests/himcm-midmcm

[9] https://www.siam.org/publications/siam-journals/siam-undergraduate-research-online-siuro

[10] https://www.siam.org/programs-initiatives/professional-development/career-fairs

[11] https://www.siam.org/get-involved/connect-with-a-community/activity-groups/applied-mathematics-education

Take Advantage of SIAM's Visiting Lecturer Program

Hearing directly from working professionals about research, career opportunities, and general professional development can help students gain a better understanding of the workforce. SIAM facilitates such interactions through its Visiting Lecturer Program (VLP), which provides the SIAM community with a roster of experienced applied mathematicians and computational scientists in academia, industry, and government. Mathematical sciences students and faculty—including SIAM student chapters—can invite VLP speakers to their institutions to present about topics that are of interest to developing mathematicians. Talks can be given in person or virtually.

The SIAM Education Committee[1] sponsors the VLP and recognizes the need for all members of our increasingly technological society to familiarize themselves with the applications and achievements of mathematics, computational science, and data science. Points to consider in advance when deciding to host a visiting lecturer include the choice of dates; potential speakers and topics; and any additional or related activities, such as follow-up discussions. Read more about the program and view the current list of participants on the VLP webpage.[2]

[1] https://www.siam.org/get-involved/connect-with-a-community/committees/education-committee

[2] https://www.siam.org/programs-initiatives/programs/visiting-lecturer-program

Celebrating a Century of Quantum Science: *SISC* Special Section on Quantum Computing

By Hans De Sterck, Matthias Möller, and Roel Van Beeumen

Over the last decades, quantum computing has evolved from a speculative idea into a rapidly advancing scientific and technological discipline. Qubit counts have surpassed the thousand-qubit mark, researchers have demonstrated early fault-tolerant logical qubits, and multiple competing hardware platforms now appear on commercial vendor roadmaps. These developments are accompanied by corresponding advances in quantum algorithms and software frameworks that test, benchmark, and scale quantum capabilities.

At the same time, the mathematics and scientific computing communities are actively working to shape the intellectual foundations of this emerging field [4]. SIAM has been central to this momentum, having recently hosted the three-day SIAM Quantum Intersections Convening,[1] which took place in Tysons, Va., in October 2024 and brought together leaders from numerical linear algebra, computational science, optimization, quantum information, and high-performance computing to discuss developments in quantum computing [6]. This interactive workshop sought to increase the involvement and visibility of mathematicians and statisticians in the quantum realm.

Prior to the convening, *SIAM News* published a two-part special issue on quantum computing—spearheaded by David Hyde of Vanderbilt University and Alex Pothen of Purdue University—that included seven total articles from experts in the field [2, 3]. The articles are part of *SIAM News'* larger collection of quantum computing material[2] and addressed a variety of topics, from the fundamentals of quantum computing and its interplay with machine learning to the importance of end-to-end complexity for quantum algorithms and the challenges that accompany noisy intermediate-scale quantum (NISQ) devices.

These collective efforts preceded a broader global moment: the United Nations' designation of 2025 as the International Year of Quantum Science and Technology[3] (IYQ). This distinction celebrated the centennial of the development of modern quantum mechanics that started with physicist Werner Heisenberg's seminal 1925 paper titled "On the Quantum-theoretical Reinterpretation of Kinematical and Mechanical Relationships," which is commonly known as the "Umdeutung" (reinterpretation) paper [1]. Generally speaking, the development of quantum computing can be organized into five broad periods (see Figure 1):

1. Birth of quantum mechanics (1925-1930)
2. The idea of quantum computing (1981-1985)
3. Quantum algorithms that change the landscape (1990s-2000s)
4. Quantum signal processing and block encodings (2016-2018)
5. From NISQ to early fault tolerance (2018-present).

Special Section on Quantum Computing

To help consolidate and elevate this growing body of research, a Special Section of the *SIAM Journal on Scientific Computing*[4] *(SISC)* on "Quantum Computing: Numerical Algorithms and Applications"[5] is accepting submissions until **April 30, 2026**. The section aims to serve as a central venue for rigorous, reproducible, and practically relevant research at the interface of quantum and scientific computing. The review process for each manuscript will begin immediately after submission, and papers will be published online on a rolling basis shortly after their acceptance.

The scope of this Special Section is broad. The first focus area is "Quantum Algorithms for Scientific Computing Applications," which encompasses subjects like quantum algorithms for the solution of differential equations, linear and nonlinear systems, eigenvalue problems, preconditioning, optimization, and machine learning. Applications may include fluid mechanics; solid mechanics; physics; materials science; and other areas of science, engineering, and technology. The second area of focus is "Scientific Computing Methods for Quantum Computing Science," which will explore topics such as tensor network representations to speed up quantum computing simulators, numerical methods to model physical qubits and quantum processors, and numerical optimal control methods for the design of quantum gates and pulse shapes.

Submissions to the *SISC* Special Section should present algorithmic contributions in the context of a full algorithmic stack that advances end-to-end quantum applications, rather than focusing on some core components of quantum algorithms in isolation. This specification includes concrete approaches for the two demanding steps to prepare the initial quantum state prior to computation (i.e., the *state preparation problem*) and extract the result after computation (i.e., the *state readout problem*). The section's overall scope includes various quantum computing technologies, such as gate-based quantum computers (see Figure 2), quantum annealers, and hybrid quantum-classical approaches. Evaluation of the proposed numerical algorithms for computational experiments—in either simulation environments or on actual quantum hardware—is a mandatory requirement of all submissions, as is comparison to best-in-class alternatives.

The Special Section's longer-term goal is to position *SISC* as a prominent outlet in the SIAM journal ecosystem for high-quality research results on quantum algorithms for scientific computing applications, as well as scientific computing approaches for quantum computing science.

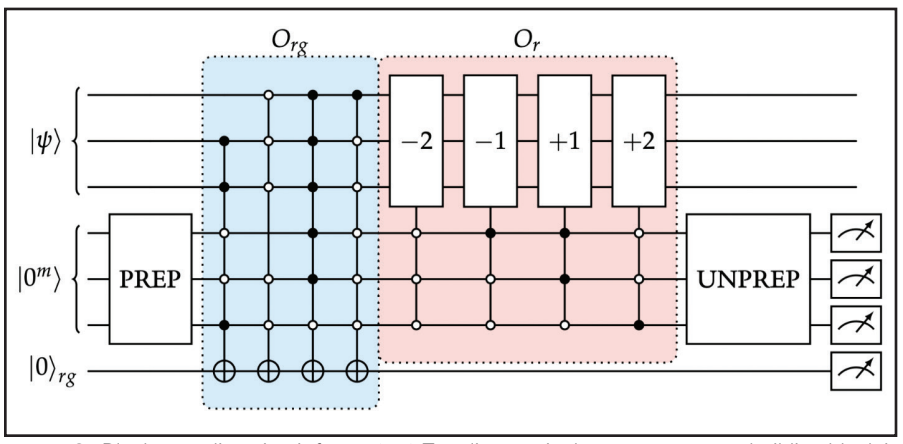

Figure 2. *Block-encoding circuit for an 8×8 Toeplitz matrix that can serve as a building block in a quantum algorithm to solve partial differential equations on a gate-based quantum computer via finite difference methods. Figure courtesy of [5].*

The Quest for Practical Quantum Advantage

Quantum advantage—a quantum computer's achievement of computational performance that is unobtainable on classical hardware—remains a widely discussed goal in both academia and industry. Proof-of-principle algorithms have been proposed, and vendor roadmaps outline increasingly ambitious fault tolerance milestones. Nevertheless, many challenges remain. Current devices face strict coherence limits, severe circuit-depth constraints, and non-negligible error rates. Even as hardware continues to improve, the translation of asymptotic algorithmic speedups into practical advantage requires careful analysis, sophisticated numerical techniques, and the scrutiny of an applied mathematics community that is experienced in connecting theory and computation.

SIAM is poised to lead these developments, as both the aforementioned SIAM Quantum Intersections Convening and IYQ 2025 underscored the need to strengthen mathematical foundations as quantum technologies mature. With the rapid spread of quantum-related conferences and preprints, the literature has become highly fragmented across physics, engineering, and computer science journals. Many papers omit crucial algorithmic components, such as state preparation strategies, full resource estimates, numerical validation, or explicit circuit constructions. Others introduce abstract oracles but fail to show whether they can be made practical on hardware.

As a society for *industrial* and applied mathematics with more than 14,000 members around the world, SIAM is uniquely positioned to foster the creation of an international community of mathematicians and domain experts to fill this knowledge gap. The *SISC* Special Section is a strong step in this direction. SIAM has successfully established bridges between mathematical theory and real-world applications in science, engineering, and industry for more than 70 years, and we hope that this Special Section will help to extend the story from scientific computing to scientific *quantum* computing — creating a much-needed, dedicated space at the intersection of applied mathematics and quantum computing.

An Exciting Path Forward

An ever-growing list of international conferences and workshops include quantum algorithms for scientific computing as part of their programs. What began as isolated minisymposia sessions has evolved into a sustained, multi-conference presence across the computational science landscape. Recent years have seen quantum-focused

See **Quantum Computing** *on page 12*

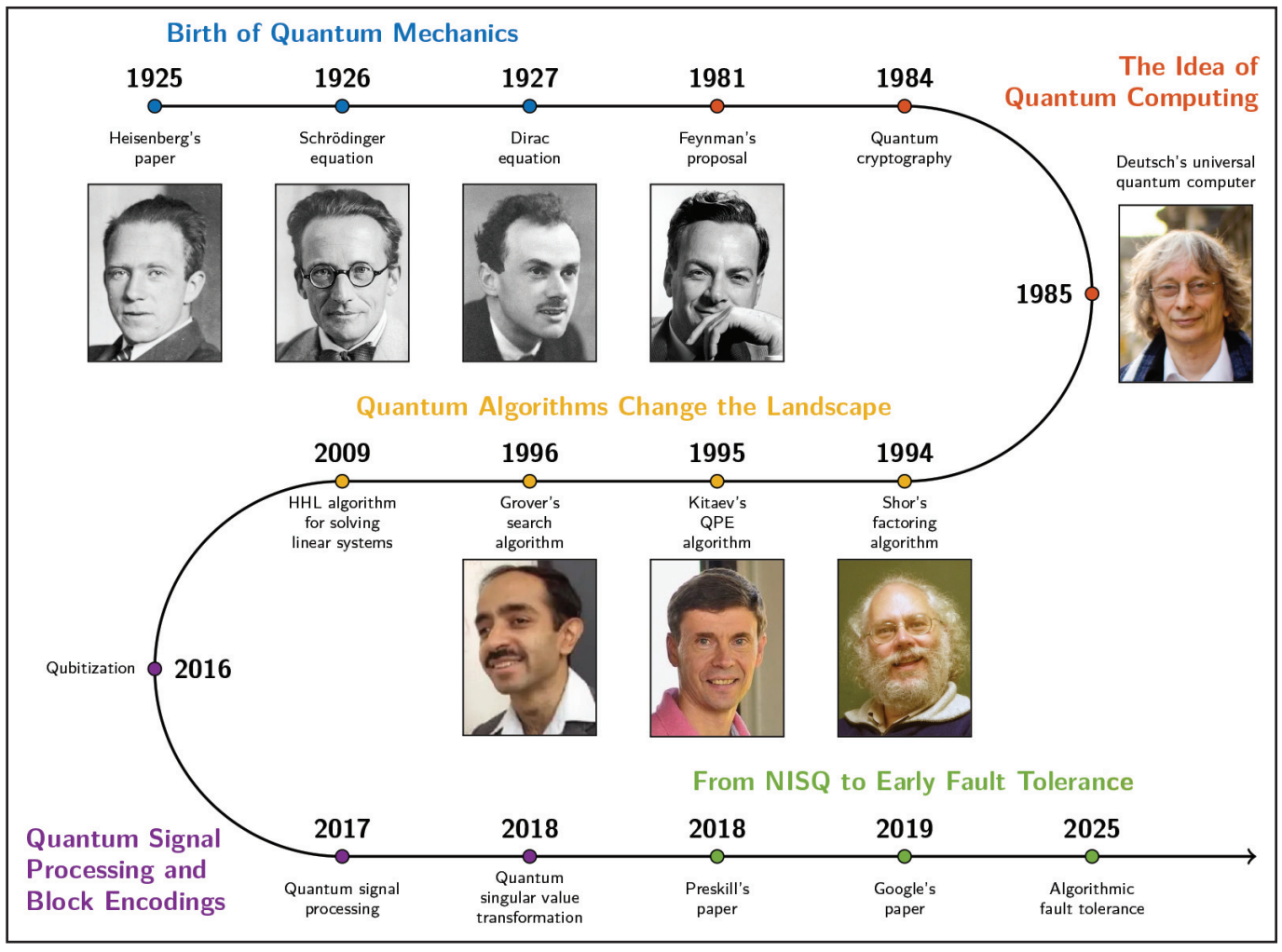

Figure 1. *A century of quantum science and computing, from 1925 to 2025. The timeline highlights five major developmental periods that are relevant to numerical mathematics and scientific computing. Figure courtesy of Roel Van Beeumen.*

[1] https://www.siam.org/publications/reports/siam-quantum-intersections-convening

[2] https://go.siam.org/quantum-computing

[3] https://quantum2025.org

[4] https://www.siam.org/publications/siam-journals/siam-journal-on-scientific-computing

[5] https://www.siam.org/publications/siam-news/articles/call-for-papers-sisc-special-section

SIAM Texas-Louisiana Section Holds 8th Annual Meeting

By Annalisa Quaini and William Ott

The Texas-Louisiana Section of SIAM[1] held its 8th Annual Meeting[2] (TXLA 2025) on a beautiful fall weekend in late September at the University of Texas at Austin's Oden Institute for Computational Engineering and Sciences.[3] Conference attendance has been steadily growing over the years, and the 2025 meeting attracted more than 350 participants — most of whom were students (both graduate and undergraduate) and early-career researchers. Such a strong junior presence is by design, in that the event is very affordable and provides students with an excellent opportunity to present their research to an audience that includes internationally renowned experts in the field of applied mathematics. Additionally, the Texas-Louisiana Section annually awards 20 travel grants to encourage participation from students who are affiliated with local universities. This time, we were particularly happy to also welcome attendees from all over the country, which attests to the conference's high scientific quality and growing stature.

The annual meeting routinely follows a well-tested formula that includes four plenary speakers, a career panel, a poster session, and five minisymposium blocks (with up to 17 parallel sessions in 2025), all between Friday and Sunday afternoon. Four esteemed leaders in the field of applied and computational mathematics delivered plenary talks on the following broad-interest subjects:

- Jean-Luc Guermond (Texas A&M University): "An Overview of Structure-preserving Approximation of Nonlinear Conservation Equations"
- Robert Lipton (Louisiana State University): "Damage and Fracture in Quasi-brittle Materials"
- Xiaoye Sherry Li (Lawrence Berkeley National Laboratory): "Building a Gaussian Process Statistical and Quantitative Learning Framework for Scientific Applications"
- Robert Ghrist (University of Pennsylvania): "Local-to-global: Network Sheaves and Cohomological Inference."

During the career panel, participants David Fridovich-Keil (University of Texas at Austin), Jon Loftin (MathWorks[4]), and Svetlana Tokareva (Los Alamos National Laboratory) spoke about their career trajectories and fielded thoughtful questions from the audience. Moderator Weihua Geng (Southern Methodist University) kept the discussion going throughout the hourlong session.

After a full day of talks on Saturday, a lively poster session inspired a bit of friendly competition. To encourage poster presentations from attendees, we held a best poster contest whose winners received generous gift cards to purchase SIAM books.[5]

A lively career panel addressed employment trajectories in applied mathematics and related fields at the Texas-Louisiana Section of SIAM 8th Annual Meeting, which took place at the University of Texas at Austin in late September. Front, from left to right: panelists Jon Loftin (MathWorks), David Fridovich-Keil (University of Texas at Austin), Svetlana Tokareva (Los Alamos National Laboratory), and moderator Weihua Geng (Southern Methodist University) answer audience questions. Photo courtesy of Annalisa Quaini.

During the Texas-Louisiana Section of SIAM 8th Annual Meeting—which was held in September at the University of Texas at Austin's Oden Institute for Computational Engineering and Sciences—a robust poster session allowed students, early-career researchers, and established professionals the opportunity to present their work to other attendees. Winners of the best poster contest received gift cards to purchase SIAM books. Photo courtesy of Annalisa Quaini.

By popular vote, the 2025 winners and poster titles were as follows:

- Boluwatife Awoyemi (Texas Tech University): "Mapping Coexistence and Exclusion in Hybrid Timescale Systems: A Numerical Approach"
- Asikul Islam (University of Houston): "Efficient Numerical Methods for Multispecies Tumor Growth Simulations"
- Bobby Shi (University of Texas at Austin): "Efficient Tensor Decomposition Via Moment Matrix Extension"
- Damon Spencer (Rice University): "A New Approach for Solving the Mixed Integer PDE Constrained Source Inversion Problem."

Following the poster session, everyone had the chance to get better acquainted, network, and mingle at the conference banquet, which took place in the Texas Union's beautiful Shirley Bird Perry Ballroom.

In light of its success, it is worth noting that even a fruitful conference like TXLA 2025 does not come without difficulties. Historically, the meeting takes place from Friday afternoon to Sunday morning. We do not want to increase the duration of the event and complicate people's schedules, but the growing number of participants poses an organizational and logistical challenge. Moreover, it is becoming harder to avoid overlap between minisymposia with similar topics that are of interest to the same crowd.

In the future, we might experiment with some new ideas for annual meetings. For example, a closing plenary lecture would give participants an incentive to stay until the end of the conference and provide an opportunity for concluding remarks. A networking session for junior researchers might also be a beneficial way to encourage them to socialize and hopefully initiate personal and professional relationships that will last throughout their careers. With the same goal of facilitating the expansion of personal and professional networks, we are likewise considering a longer poster session for future events.

As section chair and vice chair, we cannot conclude without acknowledging the hard work of the TXLA 2025 local organizing committee at the University of Texas at Austin, including Tan Bui-Thanh, Jesse Chan, Krishnanunni C G, Gabrielle Costello, Karen Rumpf, and Maria Stanzione; section treasurer Amy Veprauskas (University of Louisiana at Lafayette); section secretary Matthias Maier (Texas A&M University); and the rest of the organizing committee. The success of TXLA 2025 is due in large part to their diligence. We hope to see everyone again next year!

Annalisa Quaini is a professor of mathematics at the University of Houston. Her research interests include computational fluid dynamics and fluid-structure interactions with applications in medicine, biomedical engineering, and atmospheric science. William Ott is a professor of mathematics at the University of Houston who works in ergodic theory and dynamical systems. He utilizes ideas from dynamical systems to solve problems in a variety of areas, including applied topology, biochemical reaction networks, glucose-insulin dynamics, and scientific machine learning.

[1] https://www.siam.org/get-involved/connect-with-a-community/sections/texas-louisiana-section-of-siam

[2] https://www.siam.org/conferences-events/section-meetings/texas-louisiana-section-of-siam-8th-annual-meeting

[3] https://oden.utexas.edu

[4] https://www.mathworks.com

[5] https://epubs.siam.org/bookstore

Quantum Computing

Continued from page 11

sessions—and in some cases, entire thematic tracks—throughout a broad range of SIAM and non-SIAM conferences, including the 2024 SIAM Conference on Applied Linear Algebra,[6] 2025 SIAM Conference on Computational Science and Engineering,[7] 39th IEEE International Parallel and Distributed Processing Symposium[8] (IPDPS 2025), 26th Conference of the International Linear Algebra Society[9] (ILAS 2025), and 15th International Conference on Spectral and High Order Methods.[10]

The first-ever thematic conference that was fully dedicated to quantum algorithms in computational science and engineering took place in October in Aachen, Germany. This meeting, titled the 1st International Conference on Applied Quantum Methods in Computational Science and Engineering[11] (AQMCSE 2025), was organized by the European Community on Computational Methods in Applied Sciences.[12] AQMCSE 2025 and the aforementioned events demonstrated both the breadth of relevant problems—e.g., linear solvers, eigenvalue estimation, partial differential equations, optimal control, drug discovery, and computational mechanics—and the diversity of algorithmic techniques, from quantum singular value transformation to hybrid quantum-classical Krylov methods.

Looking ahead, the field of quantum numerical methods is gaining additional visibility: ILAS 2026[13] in May will include invited minisymposia about quantum numerical linear algebra, IPDPS 2026[14] in May will continue its trajectory of crossover research between quantum and high-performance computing, and AQMCSE 2026[15] in September will mark the second installment of the new conference series on quantum methods. Additionally, quantum algorithms will likely feature prominently at the 17th World Congress on Computational Mechanics,[16] which will take place in July. Across these meetings, the trend is clear: quantum algorithms for scientific computing are no longer peripheral — they are rapidly becoming a sustained area of research activity.

Want to contribute to this growing area of research? The SISC Special Section on "Quantum Computing: Numerical Algorithms and Applications" is accepting submissions until ***April 30, 2026.*** *Interested authors should submit a manuscript and cover letter in PDF format to SISC's online submission site.[17] Please contact SIAM Publications Manager Heather Blythe at* ***HBlythe@siam.org*** *with any questions.*

References

[1] Heisenberg, W. (1925). On the quantum-theoretical reinterpretation of kinematical and mechanical relationships. *Zeit. Phys., 33*, 879-893.

[2] Hyde, D., & Pothen, A. (2024, April 1). An introduction to quantum computing and applied mathematics. *SIAM News, 57*(3), p. 2.

[3] Hyde, D., & Pothen, A. (2024, May 1). Introducing part II of the special issue on quantum computing. *SIAM News, 57*(4), p. 3.

[4] Nannicini, G. (2020). An introduction to quantum computing, without the physics. *SIAM Rev., 62*(4), 936-981.

[5] Patel, V.N. (2025). *Quantum algorithms for PDEs via summation-by-parts discretisations* [Master's thesis, University of Waterloo]. UWSpace.

[6] Society for Industrial and Applied Mathematics. (2025). *Report of the SIAM quantum intersections convening: Integrating mathematical scientists into quantum research.* Philadelphia, PA: Society for Industrial and Applied Mathematics. Retrieved from https://www.siam.org/media/orydkrzd/quantum-convening-report.pdf.

Hans De Sterck is a professor of applied and computational mathematics at the University of Waterloo in Canada. He is editor-in-chief of the SIAM Journal on Scientific Computing (SISC). Matthias Möller is an associate professor of numerical analysis at Delft University of Technology in the Netherlands. Roel Van Beeumen is a staff scientist at Lawrence Berkeley National Laboratory and a professor of computer science at KU Leuven in Belgium. Möller and Van Beeumen are co-editors-in-charge of the SISC Special Section on "Quantum Computing: Numerical Algorithms and Applications."

[6] https://www.siam.org/conferences-events/past-event-archive/la24

[7] https://www.siam.org/conferences-events/past-event-archive/cse25

[8] https://www.ipdps.org/ipdps2025

[9] https://ilas2025.tw

[10] https://icosahom2025.org

[11] https://aqmcse.com

[12] https://eccomas.org

[13] https://ilas2026.math.vt.edu

[14] https://www.ipdps.org

[15] https://aqmcse2026.dryfta.com

[16] https://wccm-eccomas2026.org

[17] https://sisc.siam.org/cgi-bin/main.plex

InsideSIAM
Conferences, books, journals, and activities of Society for Industrial and Applied Mathematics

siam | CONFERENCES

A Place to Network and Exchange Ideas

Upcoming Deadlines

The following events are co-located:

SIAM Conference on Parallel Processing for Scientific Computing (PP26)

March 3–6, 2026 | Berlin, Germany
siam.org/pp26 | #SIAMPP26

ORGANIZING COMMITTEE CO-CHAIRS
Hartwig Anzt, *Technical University of Munich, Germany*
Hatem Ltaief, *King Abdullah University of Science and Technology, Saudi Arabia*

EARLY REGISTRATION RATE DEADLINE
March 2, 2026

HOTEL AND TRANSPORTATION INFORMATION
Visit *siam.org/conferences* for additional information.

SIAM International Meshing Roundtable Workshop 2026 (IMR26)

March 3–6, 2026 | Berlin, Germany
siam.org/imr26 | #SIAMIMR26

WORKSHOP CHAIR
Rao Garimella, *Los Alamos National Laboratory, U.S.*

EARLY REGISTRATION RATE DEADLINE
March 2, 2026

HOTEL AND TRANSPORTATION INFORMATION
Visit *siam.org/conferences* for additional information.

SIAM Conference on Uncertainty Quantification (UQ26)

March 22–25, 2026 | Minneapolis, Minnesota, U.S.
siam.org/uq26 | #SIAMUQ26

ORGANIZING COMMITTEE CO-CHAIRS
Robert Gramacy, *Virginia Tech, U.S.*
Robert Scheichl, *Heidelberg University, Germany*
Li Wang, *University of Minnesota, U.S.*

EARLY REGISTRATION RATE and HOTEL RESERVATION DEADLINE
February 23, 2026

SIAM Annual Meeting (AN26)

July 6–10, 2026 | Cleveland, Ohio, U.S.
siam.org/an26 | #SIAMAN26

ORGANIZING COMMITTEE CO-CHAIRS
Daniela Calvetti, *Case Western University, U.S.*
Charles Wampler, *University of Notre Dame, U.S.*

SUBMISSION AND TRAVEL SUPPORT DEADLINES
January 26, 2026: Minisymposium Proposal Submission

February 16, 2026: Contributed Lecture, Poster, Miniposterium, and Minisymposium Presentation Abstract Submissions

April 6, 2026: Travel Support Application Deadline

Upcoming SIAM Events

SIAM Conference on Parallel Processing for Scientific Computing
March 3–6, 2026 | Berlin, Germany
Sponsored by the SIAM Activity Group on Supercomputing

SIAM International Meshing Roundtable Workshop 2026
March 3–6, 2026 | Berlin, Germany

SIAM Conference on Uncertainty Quantification
March 22–25, 2026
Minneapolis, Minnesota, U.S.
Sponsored by the SIAM Activity Group on Uncertainty Quantification

SIAM Conference on Nonlinear Waves and Coherent Structures
May 26–29, 2026
Montréal, Québec, Canada
Sponsored by the SIAM Activity Group on Nonlinear Waves and Coherent Structures

SIAM Conference on Optimization
June 2–5, 2026
Edinburgh, United Kingdom
Sponsored by the SIAM Activity Group on Optimization

SIAM Conference on Discrete Mathematics
June 22–25, 2026
San Diego, California, U.S.
Sponsored by the SIAM Activity Group on Discrete Mathematics

SIAM Conference on Mathematics of Planet Earth
July 6–8, 2026
Cleveland, Ohio, U.S.
Sponsored by the SIAM Activity Group on Mathematics of Planet Earth

SIAM Conference on the Life Sciences
July 6–9, 2026
Cleveland, Ohio, U.S.
Sponsored by the SIAM Activity Group on Life Sciences

2026 SIAM Annual Meeting
July 6–10, 2026
Cleveland, Ohio, U.S.

SIAM Conference on Applied Mathematics Education
July 9–10, 2026
Cleveland, Ohio, U.S.
Sponsored by the SIAM Activity Group on Applied Mathematics Education

SIAM Conference on Mathematics of Data Science
November 16–20, 2026
Salt Lake City, Utah, U.S.
Sponsored by the SIAM Activity Group on Data Science

SIAM Conference on Imaging Science
November 16–19, 2026
Salt Lake City, Utah, U.S.
Sponsored by the SIAM Activity Group on Imaging Science

SIAM International Conference on Data Mining
November 19–20, 2026
Salt Lake City, Utah, U.S.
Sponsored by the SIAM Activity Group on Data Science

Information is current as of January 8, 2026. Visit *siam.org/conferences* for the most up-to-date information.

siam | MEMBERSHIP

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SIAM Members: Renew Your SIAM Membership for 2026 at *my.siam.org*

What's new at SIAM?

- In March, SIAM launched its newest journal, *SIAM Journal on Life Sciences* (SIALS), which is now accepting submissions. SIALS will be free to read for its first two years of publication and is intended to provide a dedicated venue for high-quality research on quantitative methods applied to problems in the life sciences.
- 17 new student chapters were established in 2025. This program continues to grow and helps keep students connected to SIAM and the applied math community throughout the world.
- SIAM sections expanded their coverage with the newly approved Southwest Section of SIAM (SIAM-SWS), covering Arizona, Nevada, and New Mexico. The newly established New England Section plans to hold their inaugural annual meeting in 2026. Membership in geographic subgroups is automatic with SIAM membership and provides an opportunity for local connections with fellow SIAM members.

Free student members: Don't forget that you need to renew your membership to continue receiving benefits in 2026. Join two activity groups for free!

If you're a member of a student chapter but you're not a member of SIAM, you can join for free at *my.siam.org* to start receiving all the benefits that come with SIAM student membership. Be sure to add your chapter to your profile to ensure that your membership is free. All chapter officers are required to be SIAM members.

"Conversations with senior researchers at SIAM Conference on Applications of Dynamical Systems (DS25) provided valuable guidance on navigating an academic career, including practical advice on applying for tenure-track positions. It was particularly exciting to meet many of the researchers whose work I've followed closely. The conference strengthened my motivation to pursue my academic career."

– Edmilson Roque Dos Santos, student, Clarkson University

SIAM Offers Free Student Memberships

Professors, did you know your students are eligible for free membership if:

- Your college or university is an Academic Member of SIAM
- You have a student chapter at your school
- They are referred by a member of SIAM (like you!)

Student and early career members consistently say they joined SIAM because their advisers recommended that they do so. Go to *siam.org/membership/student* to check your students' eligibility or contact *membership@siam.org*. SIAM Student membership includes: free membership in two SIAM activity groups; subscriptions to *SIAM News* and *SIAM Review* (electronic access only for free student members); 30% discount on SIAM books; eligibility to hold office and serve on SIAM committees; free membership in your local section of SIAM; opportunities to benefit and grow both personally and professionally; plus lots more!

SIAM-Simons Undergraduate Summer Research Program Applications Are Due by February 6

Each year, the SIAM-Simons Undergraduate Summer Research Program establishes five sites across the United States for a program of research and learning in applied mathematics and computational science. One faculty mentor and two students at each site will work together as participants learn how to conduct scientific research, effectively communicate mathematics and computational science principles, and gain an improved understanding of how they can pursue a career in applied mathematics and computational science. Students and mentors from the five sites will come together via video conference to present their work, participate in professional development activities, and engage in community-building initiatives to bring all participants together and foster a strong sense of belonging.

This year's mentors and projects as well as eligibility criteria can be reviewed on the program website (*siam.org/simons*).

Students accepted to the program will:

- Receive a generous weekly stipend; expenses for lodging, meals, and travel will also be covered
- Visit the Flatiron Institute in Manhattan
- Attend a SIAM conference the following year to present their research project

This program welcomes U.S. students from groups underrepresented in applied mathematics and computational mathematics in the U.S., specifically ethnic minorities (African American/Black, Hispanic, Native American/Indigenous Peoples, Native Alaskan, Native Hawaiian/Other Pacific Islander). The program is intended to broaden participation in mathematics by students who are underrepresented and historically marginalized in our discipline.

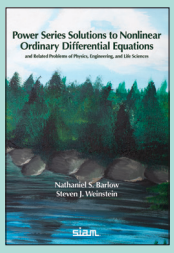
Applications must be submitted by February 6, 2026, and letters of recommendation must be submitted by February 11, 2026.

FOR MORE INFORMATION ON SIAM MEMBERSHIP: *siam.org/membership*

siam | BOOKS

Quality and Value in Mathematical Science Literature

Power Series Solutions to Nonlinear Ordinary Differential Equations and Related Problems of Physics, Engineering, and Life Sciences

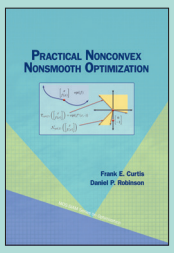


Nathaniel S. Barlow and Steven J. Weinstein

This book introduces a systematic approach to solving nonlinear ODEs using power series, with a focus on problems in mathematical physics. It equips readers with tools to streamline recursive computations and tackle convergence challenges, making power series methods both practical and accessible. Grounded in a hands-on teaching philosophy, the text features idea-driven examples and research-based problems, with minimal proofs. Ideal for applied mathematicians, scientists, and engineers, the book demonstrates how power series techniques can complement numerical methods as a versatile problem-solving tool.

2025 / xii + 261 pages / Softcover / 978-1-61197-853-7
List $84.00 / SIAM Member $58.80 / OT208

Practical Nonconvex Nonsmooth Optimization

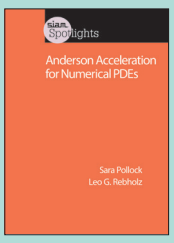


Frank E. Curtis and Daniel P. Robinson

This book provides a clear and accessible introduction to an important class of problems in mathematical optimization: those involving continuous functions that may be nonconvex, nonsmooth, or both. The authors begin with an intuitive treatment of theoretical foundations, including properties of nonconvex and nonsmooth functions and conditions for optimality. They then offer a broad overview of the most effective and efficient algorithms for solving such problems, with a focus on practical applications in areas such as control systems, signal processing, and data science.

2025 / xxiv + 491 pages / Softcover / 978-1-61197-858-2
List $92.00 / SIAM Member $64.40 / MO36

Anderson Acceleration for Numerical PDEs



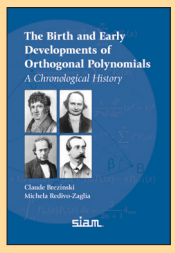
Sara Pollock and Leo G. Rebholz

Research on Anderson acceleration (AA) has surged over the last 15 years. This book compiles recent fundamental advancements in AA and its application to nonlinear solvers for partial differential equations. These solvers play an important role across mathematics, science, engineering, and economics, serving as a critical technology for determining solutions to predictive models for a wide range of important phenomena. The book covers AA convergence theory for both contractive and noncontractive operators, as well as filtering techniques for AA. It includes examples of how convergence theory can be adapted to various application problems. It also includes AA's impact on sublinear convergence and integration of AA with Newton's method.

2025 / viii + 110 / Softcover / 978-1-61197-848-3
List $54.00 / SIAM Member $37.80 / SL08

Recently Published

The Birth and Early Developments of Orthogonal Polynomials
A Chronological History

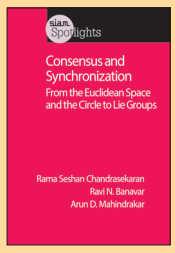


Claude Brezinski and Michela Redivo-Zaglia

The shape of the Earth was a significant scientific question in the eighteenth century. When it was discovered that the Earth was flattened at the poles, scientists sought to understand the cause, leading to the discovery of orthogonal polynomials. Over time, as interest in the gravitational problem of spheroids waned, the intrinsic mathematical interest in orthogonal polynomials took precedence. This is the first book to describe the history of orthogonal polynomials, covering their birth and early developments from the end of the 18th century to the middle of the 20th century. It includes biographies of principal and lesser-known figures, anecdotes, and accounts of the countries and institutions involved. The book will appeal to researchers, students, and those interested in the history of mathematics.

December 2025 / xxvi + 604 pages / Hardcover / 978-1-61197-850-6 / List $110.00 / SIAM Member $77.00 / OT207

Consensus and Synchronization
From the Euclidean Space and the Circle to Lie Groups

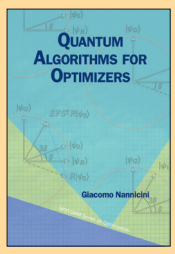


Rama Seshan Chandrasekaran, Ravi N. Banavar, and Arun D. Mahindrakar

Coordination, consensus, and synchronization are found in diverse natural phenomena and engineering applications. Examples are flocking birds, illuminating fireflies, schooling fish, and distributed control and sensing. The simplest of such problems are set in the Euclidean spaces and the circle. This book moves beyond this domain to the more sophisticated setting of Lie groups with bi-invariant metrics and extends the mathematical theories of consensus and synchronization for generic scenarios. This is relevant to applications such as robotics, autonomous vehicles, and spacecraft.

December 2025 / xii + 86 pages / Softcover / 978-1-61197-879-7 / List $54.00 / SIAM Member $37.80 / SL09

Quantum Algorithms for Optimizers

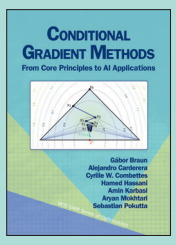


Giacomo Nannicini

This book presents a self-contained introduction to quantum algorithms, with a focus on quantum optimization—quantum approaches to solving optimization problems. It equips readers with the essential tools to assess the strengths and limitations of these algorithms, emphasizing provable guarantees and computational complexity. The first comprehensive treatment of quantum optimization, it provides a rigorous introduction to the computational model of quantum computers and to the theory of quantum algorithms, contains detailed discussions of some of the most important developments in quantum optimization algorithms, and summarizes the most significant advances in the open literature.

December 2025 / xiv + 273 pages / Softcover / 978-1-61197-875-9 / List $79.00 / SIAM Member $55.30 / MO37

Conditional Gradient Methods
From Core Principles to AI Applications



Gábor Braun, Alejandro Carderera, Cyrille W. Combettes, Hamed Hassani, Amin Karbasi, Aryan Mokhtari, and Sebastian Pokutta

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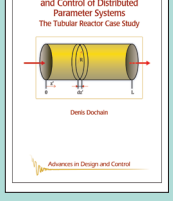

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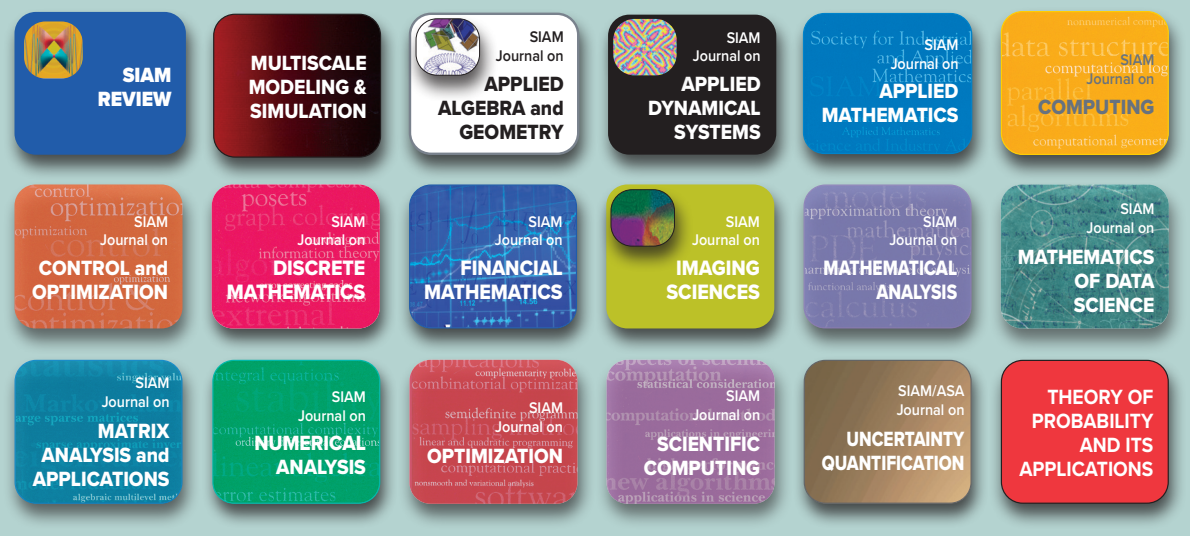

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