Natalie N. Beams

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Education

University of Illinois at Urbana-Champaign — Urbana, IL, USA

Ph.D. in Theoretical & Applied Mechanics   2017
   Thesis title: "High-order hybrid numerical methods using Green's functions
      and finite elements"
   Thesis advisors: Luke Olson, Andreas Klöckner

M.S. in Theoretical & Applied Mechanics   2014

University of Oklahoma — Norman, OK, USA
B.S. in Mechanical Engineering   2010
   Summa cum Laude

Papers

Three-precision algebraic multigrid on GPUs, Y. M. Tsai, **N. Beams,** and H. Anzt, Future Generation Computer Systems 149, 2023

Mixed Precision Algebraic Multigrid on GPUs, Y. M. Tsai, **N. Beams**, and H. Anzt, Parallel Processing and Applied Mathematics: 14th International Conference, PPAM 2022, Revised Selected Papers, Part I, 2023

libCEED: Fast algebra for high-order element-based discretizations, J. Brown, A. Abdelfattah, V. Barra, **N. Beams,** J-S. Camier, V. Dobrev, Y. Dudouit, L. Ghaffari, T. Kolev, D. Medina, W. Pazner, T. Ratnayaka, J. Thompson, S. Tomov, Journal of Open Source Software 6(63), 2021

Efficient exascale discretizations: High-order finite element methods, T. Kolev, P. Fischer, M. Min, J. Dongarra, J. Brown, V. Dobrev, T. Warburton, S. Tomov, M. S. Shephard, A. Abdelfattah, V. Barra, **N. Beams**, *et al.*, The International Journal of High Performance Computing Applications, 2021

High-Order Finite Element Method using Standard and Device-Level Batch GEMM on GPUs, **N. Beams**, A. Abdelfattah, S. Tomov, J. Dongarra, T. Kolev, Y. Dudouit, IEEE/ACM 11th Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems (ScalA), 2020

A parallel implementation of a high order accurate solution technique for variable coefficient Helmholtz problems, **N. N. Beams**, A. Gillman, and R. Hewett, Computers and Mathematics with Applications 79(4), 2020

High-order Finite Element—Integral Equation Coupling on Embedded Meshes, **N. N. Beams**, A. Klöckner, and L. N. Olson, J. Comp. Phys. 375, 2018

A Scalable Fast Method for N-body Problems Based on Exact Finite Element Basis Screen Functions, **N. N. Beams**, L. N. Olson, and J. B. Freund, SIAM J. Sci. Comput. 38(3), 2016

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Presentations

Leveraging Mixed Precision to Accelerate High-Order Finite Element Methods on GPUs, **N. Beams**, J. Brown, J. Thompson, Y. Dudouit, and W. Pazner, SIAM Conference on Parallel Processing for Scientific Computing (PP), 2022

MAGMA Backend and its Portability in Accelerating LibCEED using Standard and Device-Level Batched BLAS, **N. Beams**, A. Abdelfattah, S. Tomov, J. Dongarra, SIAM Conference on Computational Science and Engineering (CSE), 2021

Coupling MFEM with Ginkgo for efficient preconditioning on GPUs, **N. Beams**, T. Kolev, W. Pazner, H. Anzt, T. Grützmacher, P. Nayak, and T. Ribizel, CEED 4th Annual Meeting, 2020

An Efficient and High Order Accurate Solution Technique for Three Dimensional Elliptic Partial Differential Equations, **N. N. Beams** and A. Gillman, SIAM Conference on Computational Science and Engineering (CSE), 2019

A Parallel Implementation of a Hierarchical Spectral Solver for Variable Coefficient Elliptic Partial Differential Equations, **N. N. Beams**, A. Gillman, and R. Hewett, International Conference on Spectral and High Order Methods, 2018

A parallel implementation of a high order accurate variable coefficient Helmholtz solver, **N. N. Beams**, A. Gillman, and R. Hewett, SIAM Conference on Applied Linear Algebra, 2018

Targeting Interface Problems at Scale with Coupled Elliptic Solvers, **N. N. Beams**, A. Klöckner, and L. Olson, 6th Joint Laboratory for Extreme-Scale Computing Workshop, 2016

A Scalable Method for Cellular Blood Flow and Other N-body Systems, **N. N. Beams**, L. N. Olson, and J. B. Freund, University of Illinois at Urbana-Champaign Computational Science & Engineering Annual Meeting, 2013

Ordered and chaotic flow of red blood cells flowing in a narrow tube, **N. N. Beams** and J. B. Freund, 66th Annual Meeting of the American Physical Society Division of Fluid Dynamics, 2013

Stability of red cells flowing in narrow tubes, **N. N. Beams** and J. B. Freund, 64th Annual Meeting of the American Physical Society Division of Fluid Dynamics, 2011

Program Visualization Tool for Educational Code Analysis, **N. N. Beams**, 2010 Global Conference on Educational Robotics

Posters

A parallel implementation of a high order accurate variable coefficient Helmholtz solver, **N. N. Beams**, A. Gillman, and R. Hewett, Rice Oil & Gas HPC Conference, 2018

A method for N-Body problems based on exact finite element basis screen functions, **N. N. Beams**, L. N. Olson, and J. B. Freund, SIAM Conference on Computational Science and Engineering, 2015

Research Positions

Innovative Computing Laboratory, University of Tennessee — Knoxville, TN, USA

Research Scientist I, Linear Algebra group   Aug. 2019 —

Rice University — Houston, TX, USA

Postdoctoral Research Associate, Computational and Applied Mathematics   Aug. 2017—
   Advisor: Adrianna Gillman   Aug. 2019

Teaching Experience

University of Illinois at Urbana-Champaign — Urbana, IL, USA

Teaching Assistant for CS 556, Iterative & Multigrid Methods   Fall 2016

Teaching Assistant for CS 555, Numerical Methods for PDEs   Spring 2015

Teaching Assistant for TAM 335, Introductory Fluid Mechanics   Fall 2014
   Instructor of 3 lab sections

University of Oklahoma — Norman, OK, USA

Engineering Dean's Leadership Council Peer Tutor   2007-2009
   Assisted students with homework assignments and understanding of course
   material; worked with the Multicultural Engineering Program to promote success
   for minority students

Programming & Software

Languages with significant programming experience: **C/C++, Python, Fortran** (90/95), Matlab
Parallel implementation: **CUDA/HIP** and **SYCL** on GPUs, **OpenMP**, some experience with MPI

Contributor to open-source software packages:
    libCEED (https://github.com/CEED/libCEED), MFEM (https://github.com/mfem/mfem)

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Awards & Honors

Best Workshops Paper Award, PPAM22 (for *Mixed Precision Algebraic Multigrid*   2022
    on GPUs with Y. M. Tsai and H. Anzt)

Recipient of Early Career Travel Award for SIAM Conference on Applied Linear Algebra   2018

Invited participant of "Integral Equation Methods, Fast Algorithms and   2017
Their Applications to Fluid Dynamics and Materials Science" International Program
    Institute for Computational and Experimental Research in Mathematics (ICERM)
    and Hong Kong University of Science and Technology (HKUST)

Named to "List of Teachers Ranked as Excellent by Their Students"   Fall 2014
    TA for TAM 335, Introductory Fluid Mechanics

University of Illinois Computational Science & Engineering Fellow   2011-2013

University of Illinois Carver Fellow   2010-2011
    One of four incoming graduate students chosen across the College of Engineering

Outstanding Sophomore in Mechanical Engineering   2007-2008

Member, Tau Beta Pi & Pi Tau Sigma

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Service

Reviewer for:
    SIAM Journal of Scientific Computing
    Parallel Computing
    Computing
    Computer Physics Communications

Program committee member:
    International Supercomputing (ISC) 2023 — Workshops
    51st International Conference on Parallel Processing (2022) — Algorithms
    International Supercomputing (ISC) 2022 — Workshops
    50th International Conference on Parallel Processing (2021) — Algorithms
    35th IEEE International Parallel & Distributed Processing Symposium (2021) —
        System Software

Officer for MechSE Graduate Women student organization   2012-2014