M. Naqib Rahimi, Ph.D. Candidate

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Summary:
I am a Ph.D. candidate in Civil Engineering specializing in fluid-structure interaction, failure modeling, and finite element analysis. I have extensive experience developing advanced algorithms for failure simulations in multi-physics environments, with a focus on Smoothed Particle Hydrodynamics (SPH), FEM, Peridynamics, Isogeometric Analysis, and Phase Field methods. I also possess hands-on expertise in high-performance computing, including CUDA parallelization.

EDUCATION

2021 – Now **Ph.D. in Civil engineering., Stony Brook University**
Thesis title: Computational mechanics of extreme events: Advanced multi-physics simulations with Smoothed Particle Hydrodynamics, Isogeometric Analysis, Micro Plane Model, and Phase Field.

2019 – 2021 **M.Sc. in Material Science and Nanoengineering, Sabanci University**
Thesis title: Peridynamic Modeling of Internal Features and Interfaces for Material Toughening.

2015 – 2021 **B.Sc. in Mechanical Engineering, Inonu University**
Thesis title: Energy Assessment of Bio-wastes in Afghanistan's Kunar city.

2014 – 2018 **B.Sc. in Civil Engineering, Inonu University**. Honors degree
Thesis title: Excel-based Programming in Civil Engineering.

SKILLS

Coding	C++, Python, Fortran, MATLAB, CUDA, and FEniCS.
Methods	SPH, Phase Field, Finite Element, Isogeometric Analysis, Peridynamics.
Softwares	ANSYS, SolidWorks, AutoCAD.
Post/Pre-processing	ANSA, LS-PrePost, ParaView, GiD, and Corel Draw.
Languages	English, Persian, Turkish, Hindi, and Pashto.

FUNDED PROPOSALS

2024 – Now **CAREER: Open-Source GPU-Accelerated Computational Infrastructure for Coastal Fluid-Structure Interaction in Extreme Hydrodynamic Conditions**
Research Assistant (NSF AWARD #: 2338313)
PI: Georgios Moutsanidis
- Developed a fully SPH-based solver for failure analysis of structure in FSI scenarios.
- Generated preliminary results for the award.

2020 – 2022 **Development and Experimental Validation of Parallelized Hybrid SPH-PD Particle Method for Fluid-Solid Interaction Solutions of Hydro-elasticity Problems**
Primary Investigator (TUBITAK Project ID: 121M425)
- Developed a GPU solver for failure analysis of linear elastic brittle structures in turbulent channels.
- Designed experimental setup for validation purposes.

2020 – 2021 **Parallelized Hybrid Particle Methods Supported by Innovative Non-local Models: Applications to Fluid-Structure-Interaction Analysis**
Primary Investigator (Project ID: B.A.KM-21-02377)
- Developed a new SPH-Peridynamics numerical method for failure analysis of structures in multi-physics scenarios.

2019 – 2021 **Structural Health Monitoring of Sandwich Composites by Combining Peridynamics and iFEM Methodology: Theoretical Modeling, Numerical Analysis, and Experimental Verification**
Research Assistant (TUBITAK Project ID: 217M207)
- Developed numerical techniques for health monitoring of airplane wings.
- Assisted in the manufacturing and testing of a composite wings.

2017 – 2018 **Design of Unmanned Ground Vehicle for Anti-Terrorism and Defense**
Research Assistant (BAP Project ID: FLO-2018-1028)
- Participated in designing a UGV for anti-terrorism purposes.
- Used FEM to model the vehicle and analyze its behavior under various conditions.

JOB EXPERIENCE

May 2024 – Aug 2024 **R&D Simulation Engineer Intern,** ANSYS-LSDYNA.

- Continued working on similar topics from the previous year.
- Took on the integration of CUDA parallelization into parts of the ANSYS-LSDYNA code.
- Led the first steps in transforming a significant portion of the ANSYS-LSDYNA base code to CUDA parallel architecture.

May 2023 – Aug 2023 **R&D Simulation Engineer Intern,** ANSYS-LSDYNA.

- Developed parallel algorithms for ANSYS-LSDYNA software to simulate airbag behavior during car crashes.
- Conducted FEM analyses and meshing for complex geometries.
- Performed mesh cleaning and re-meshing of airbags using ANSA and LS-PrePost.

Jun 2017 – Aug 2017 **Engineer Intern,** Inonu University Department of Constructions.

- Led a team of 9 interns in construction activities at Inonu University's campus.
- Participated in the construction of various new buildings, including a bridge, amphitheater, and student activity center.

Jun 2016 – Aug 2016 **Engineer Intern,** Guven Constructions.

- Reported workflow and material usage for ongoing construction sites.
- Engaged in regular standardization and quality control activities.

AWARDS

2024 **IACS Junior Researcher Award**
Presented by the Institute for Advanced Computational Science (IACS) to PhD students for their outstanding research achievements.

SBU Civil Engineering Research Merit Award
Recognizes exceptional research contributions from a graduate student in the Department of Civil Engineering at Stony Brook University.

2023 **First Place Award**
Awarded first place by the Fluid Dynamics Committee of the U.S. Engineering Mechanics Institute (EMI), a technical committee of the American Society of Civil Engineers (ASCE).

2019 **Summa Cum Laude Award**
Ranked 1st out of 940 students in the Faculty of Engineering, Inonu University.

2018 **First Place in National Undergraduate Thesis Competition**
Awarded by the Scientific and Technological Research Council of Turkey (TUBITAK) for outstanding undergraduate thesis work.

2017 **Young Merit Award**
Presented by the MISA Organization for exceptional academic and personal achievements.

2011 **Silver Medalist in Mathematics**
Achieved silver at the International Science Olympiad (ISO) in Abuja, Nigeria.

2010 **Gold Medalist in Mathematics**
Awarded the gold medal at the National Mathematics Olympiad in Afghanistan.

SCHOLARSHIPS

2019 **Master's Scholarship**
2015 **Undergraduate Scholarship (Mechanical Engineering)**
2013 **Presidential Scholarship (Civil Engineering)**
2008 **High School Scholarship**

TEACHING EXPERIENCE

Jan 2024 – May 2024 **Steel and Reinforced Concrete Design I (CIV312)**
Jan 2021 – Jul 2021 **Calculus (Math102)**
Sep 2020 – Jan 2021 **Manufacturing Processes (IE309)**
Jan 2020 – June 2020 **Int. to Material Science (ENS205)**
Jan 2019 – Jan 2020 **Calculus (MATH102)**
Jan 2019 – Apr 2019 **Dynamics (DNK201)**

PUBLICATIONS

Journal Articles

[11] **M. N. Rahimi** and G. Moutsanidis, "Modeling concrete failure with smoothed particle hydrodynamics using the microplane (m7) constitutive model," *In Press*, Jan. 2025.

[10] **M. N. Rahimi**, G. Moutsanidis, and L. Svolos, "Phase field modeling of dynamic brittle fracture in functionally graded materials under thermal shock," *In Press*, Mar. 2025.

[9] **M. N. Rahimi** and G. Moutsanidis, "Iga-sph: Coupling isogeometric analysis with smoothed particle hydrodynamics for air-blast–structure interaction," ***Engineering with Computers***, pp. 1–22, May 2024. DOI: https://doi.org/10.1007/s00366-024-01978-0.

[8] **M. N. Rahimi** and G. Moutsanidis, "An sph-based fsi framework for phase-field modeling of brittle fracture under extreme hydrodynamic events," ***Engineering with Computers***, Aug. 2023. DOI: https://doi.org/10.1007/s00366-023-01857-0.

[7] **M. N. Rahimi**, D. C. Kolukisa, M. Yildiz, M. Ozbulut, and A. Kefal, "A Generalized Hybrid Smoothed Particle Hydrodynamics-Peridynamics Algorithm with a Novel Lagrangian Mapping for Solution and Failure Analysis of Fluid-Structure Interaction Problems," ***Computer Methods in Applied Mechanics and Engineering***, Feb. 2022, (Highly cited). DOI: 10.1016/j.cma.2021.114370.

[6] **M. N. Rahimi** and G. Moutsanidis, "A smoothed particle hydrodynamics approach for phase field modeling of brittle fracture," ***Computer Methods in Applied Mechanics and Engineering***, Aug. 2022. DOI: https://doi.org/10.1016/j.cma.2022.115191.

[5] **M. N. Rahimi** and G. Moutsanidis, "Modeling dynamic brittle fracture in functionally graded materials using hyperbolic phase field and smoothed particle hydrodynamics," ***Computer Methods in Applied Mechanics and Engineering***, Nov. 2022. DOI: https://doi.org/10.1016/j.cma.2022.115642.

[4] **M. N. Rahimi**, A. Kefal, and M. Yildiz, "An improved ordinary-state based peridynamic formulation for modeling FGMs with sharp interface transitions," ***International Journal of Mechanical Sciences***, May 2021. DOI: 10.1016/j.ijmecsci.2021.106322.

[3] B. AlKhateab, I. E. Tabrizi, J. S. M. Zanjani, *et al.*, "Damage mechanisms in CFRP/HNT laminates under flexural and in-plane shear loadings using experimental and numerical methods," ***Composites Part A:*** *Applied Science and Manufacturing*, Oct. 2020. DOI: 10.1016/j.compositesa.2020.105962.

[2] **M. N. Rahimi**, A. Kefal, M. Yildiz, and E. Oterkus, "An ordinary state-based peridynamic model for toughness enhancement of brittle materials through drilling stop-holes," ***International Journal of Mechanical Sciences***, Sep. 2020. DOI: 10.1016/j.ijmecsci.2020.105773.

[1] **M. N. Rahimi** and O. H. Bettemir, "Development of an Unmanned Ground Vehicle for Shelter and Cave Reconnaissance and annihilation," *Savtek 2018 9. Defence Technologies*, vol. 1, no. -, pp. 761–771, Apr. 2018.

Conference Proceedings

[8] **M. N. Rahimi**, G. Moutsanidis, and L. Svolos, "Dynamic crack propagation in functionally graded materials under thermal shock: A novel phase field approach," in *Engineering Mechanics Institute Conference and Probabilistic Mechanics and Reliability Conference (EMI/PMC 2024) in Chicago, Illinois, May 28-31, 2024*, May 2024.

[7] **M. N. Rahimi** and G. Moutsanidis, "High Fidelity Modeling of Fracture Under Extreme Hydrodynamic Events: A Coupled SPH-Phase-Field FSI Approach," in *Engineering Mechanics Institute Conference 2023 (EMI 2023) in Atlanta, Georgia, June 6-9, 2023*, Jun. 2023.

[6] D. C. Kolukisa, R. Saghatchi, **M. N. Rahimi**, G. Moutsanidis, and M. Yildiz, "SPH-PD Modeling of the Periodic Elastic Response of a Beam Behind a Cylinder in Laminar Incompressible Flow," in *The 12th TSME International Conference on Mechanical Engineering in Phuket, Thailand*, Dec. 2022.

[5] G. Moutsanidis and **M. N. Rahimi**, "SPH framework for Modeling Fracture in Fluid-Structure Interaction: a comparative study between phase field and peridynamics," in *Meshfree and Novel Finite Element Methods with Applications in Berkeley, California*, Jun. 2022.

[4] **M. N. Rahimi** and G. Moutsanidis, "A coupled total Lagrangian SPH-phase field framework for brittle fracture," in *16th SPHERIC in Catania, Italy*, Jun. 2022.

[3] **M. N. Rahimi** and G. Moutsanidis, "SPH framework for Hyperbolic phase field modeling of brittle fracture," in *Meshfree and Novel Finite Element Methods with Applications in Berkeley, California*, Jun. 2022.

[2] **M. N. Rahimi**, A. Kefal, and M. Yildiz, "Numerical Investigation on Effective Toughening Mechanisms of Graded Composites," in *JOINT EVENT: ICCS23 - 23rd International Conference on Composite Structures & MECHCOMP6 - 6th International Conference on Mechanics of Composites*, Elsevier, Mar. 2020, p. 151.

[1] **M. N. Rahimi**, O. F. Bulak, and O. H. Bettemir, "Excel Based Program Modeling and Project Management Application Development.," in *Tubitak Project Competition Proceedings*, The Scientific and Technological Research Council of Turkey (TUBİTAK), 2018, p. 87.

References

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