K Prahlad Narasimhan

kprahlad.narasimhan@niser.ac.in
kprahlad.github.io

Research Interests

I enjoy working on algorithmic problems involving computational geometry and graph theory. Currently, I am working on the optimality of local search algorithms for geometric hitting set problems and the parameterized complexity of the Dominator Coloring problem. I am also interested in approximation algorithms, parameterized complexity, and optimization theory.

Education

National Institute of Science Education and Research — Bhubaneswar, OD
Int. MSc. in Mathematics (CGPA: 8.84), Minor in Computer Science (CGPA: 9.78) — *July 2017 – Present*

Vidya Mandir - Mylapore — Chennai, TN
AISSCE percentage: 96.2%, AISSE GPA: 10 — *June 2013 – May 2017*

Publications

[C1] Kasthurirangan Prahlad Narasimhan. One-Sided Discrete Terrain Guarding and Chordal Graphs. In *7th Conference on Algorithms and Discrete Applied Mathematics (CALDAM 2021)*, pages 122-134, 2021. DOI.

Abstract: The main result of the paper proves that a restricted version of the Terrain Guarding problem is equivalent to the Clique Cover problem in chordal graphs, extending a result proved for orthogonal terrains in [1]. This work is a step forward in understanding the longstanding question on whether Terrain Guarding, parameterized by the size of the guard set, is fixed-parameter tractable.

The full version of the paper, currently in review in *Discrete Applied Mathematics*, extends the results proved in [C1] to the Continuous Terrain Guarding problem and to the Dominating Set problem restricted to terrain-like graphs. It also significantly shortens the proof of one of its theorems.

Talks and Presentations

The Four-Color Theorem — Bhubaneswar, OD
Online presentation as part of the Harvard GSAS Mini-Course on Computation — *January 2022*

Guarding Terrains and Covering Chordal Graphs — Bhubaneswar, OD
Online presentation of [C1] at CALDAM 2021 — *February 2021*

Research Internships

Parameterized Complexity of Dominator Coloring — NISER, Bhubaneswar, OD
With Dr. Aritra Banik and Dr. Venkatesh Raman — *November 2021 – Present*

- Working on finding efficient FPT algorithms for Dominator Coloring parameterized by those parameters that measure the distance between a graph and a tractable graph class.
- Obtained preliminary results for two parameters.

Geometric Hitting Set Problems Using Local Search NISER, Bhubaneswar, OD
With Dr. Aritra Banik and Dr. Rajiv Raman *June 2021 – October 2021*

- Understood the seminal work on the PTAS for geometric hitting set problems using local search [2], the algorithm's optimality [3], and a few of its applications [4], [5].
- Working on (dis)proving that the state-of-the-art PTAS for Terrain Guarding is optimal.

Optimization Constructs NISER, Bhubaneswar, OD
With Dr. Aritra Banik and Dr. Sutanu Roy *August 2020 – January 2021*

- Worked on linear and semidefinite optimization and explored its uses in approximation of NP-Hard problems.
- A part of my 7^{th} semester assessment. Report.

Terrain Guarding NISER, Bhubaneswar, OD
With Dr. Aritra Banik *March 2020 – October 2020*

- Worked on fixed-parameter tractable and approximation algorithms in the context of computational geometry.
- Presented my work [C1] on the Terrain Guarding problem at CALDAM 2021. Report.

Cellular Automata IIT, Kharagpur, WB
Under Dr. Dipanwita Roychowdhury *May 2019 – June 2019*

- Worked on the cryptographic applications of cellular automata. Understood a seminal work [6] in this area.
- Synthesized non-hybrid cellular automata from irreducible polynomials. Report.

Automata Theory CMI, Chennai, TN
Under Dr. S.P Suresh *June 2018 – August 2019*

- An introductory reading project on the theory of automata from *"Automata and Computability"* by D. C. Kozen [7].
- Reduced the number of axioms required to define a Kleene algebra (algebra of regular languages) by one through the course of the year. Report.

Fellowships and Awards

- Awarded "**Best Student Paper Presentation**" at CALDAM 2021 [8].
- INSPIRE SHE - Merit based scholarship awarded by the Department of Science and Technology - Government of India, which **fully funds** my education at NISER. Duration: July 2017 to May 2022.
- IAS SRF - Summer research fellowship awarded by the Indian Academy of Sciences to around two thousand students (acceptance rate of 10%) to pursue a summer internship at a research lab anywhere in the country. Duration: May 2019 to June 2019.

Mentorship and Volunteering

- Teaching assistant for the Mini-Course on Computation organized by Chi-Ning Chou at Harvard University in January 2022.

- Mentored three freshmen in 2020 and 2021 for a talk series hosted by NISER's mathematics club titled "The Mathematics of Logic".
- Designed a T-Shirt for Zaariya, the social service club of NISER, in 2018. The club raised in excess of Rs. 84,000 and redirected the profits to fund projects focusing on educating underprivileged students from the rural parts of Odisha.

Science Outreach

NiSERCast NISER, Bhubaneswar, OD
Host of a podcast aimed at high school students *April 2021*

- Hosted Prof. V. Muruganandam in the inaugural episode of the podcast to talk about life as a first-generation student in academia, the effects of technology on his research, and his work on mathematics outreach programs across the country.
- Available on Spotify, Apple Podcasts, and Google Podcasts.

NISER Open Day NISER, Bhubaneswar, OD
Introducing high school students to the sciences *2017 - 2020*

- Gave talks and demonstrations to high school students on mathematics and computer science in 2017, 2018, and 2019.
- Head of the design team and computer science wing of the program in 2020.

Student-Run Clubs NISER, Bhubaneswar, OD
Interdisciplinary talks aimed at undergraduates *2017 – 2019*

- Delivered talks titled "The Four Number Game" and "An Introduction to Kleene Algebras" at NISER's mathematics club in 2018 and 2019.
- Gave a talk on "Computing with DNA" based on [9] in 2017 at NISER's biology club.

Language Proficiency

- Proficient in Tamil (native tongue), English, and Hindi.
- TOEFL iBT - 114 out of 120. Test taken on September 18, 2021.
- General GRE - 332 out of 340. Test taken on September 16, 2021.