List of Publications

Pranav Bisht

January 2023

1. **Derandomization via symmetric polytopes: Poly-time factorization of certain sparse polynomials** (link)
   with Nitin Saxena.
   42nd IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS), 2022.

   The problem of multivariate polynomial factorization is well studied and admits an efficient randomized algorithm for general arithmetic circuits. Derandomizing this even for very restricted circuit classes is open. In particular, given a sparse polynomial of constant individual degree as an explicit list of monomials, factoring it in deterministic polynomial time is open. We solve this problem for the case when the input sparse polynomial is symmetric, by utilizing techniques from convex geometry and proving a crucial result about the symmetric Newton polytope of the input polynomial.

2. **On Solving Sparse Polynomial Factorization Related Problems**(link)
   with Ilya Volkovich.
   42nd IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS), 2022.

   Bhargava, Saraf and Volkovich (FOCS'18; JACM'20) proved the first factor sparsity bound for constant individual degree polynomials. In particular, they show that any factor of an n-variate polynomial with at most s terms and individual degree bounded by d can itself have at most $s^{O(d^2 \log n)}$ terms. It is conjectured, though, that the "true" sparsity bound should be polynomial (i.e. $s^{\mathrm{poly}(d)}$). In this paper we provide supporting evidence for this conjecture by presenting polynomial-time algorithms for several problems that would be implied by a polynomial-size sparsity bound. In particular, we give efficient deterministic algorithms for identity testing of $\Sigma^{[2]}\Pi\Sigma\Pi^{[\text{ind-deg } d]}$ arithmetic circuits and testing if a sparse polynomial is a perfect power.

3. **Blackbox identity testing for sum of special ROABPs and its border class** (link)
with Nitin Saxena.
Journal: Computational Complexity, 2021.

The Polynomial Identity Testing (PIT) problem is a well-known problem with an efficient randomized algorithm and various interesting subclasses of arithmetic circuits are studied in order to obtain deterministic PIT algorithms. In this paper, we study the class of read-once oblivious arithmetic branching programs (ROABPs). We give the first poly(s)-time blackbox deterministic PIT for sum of constant-many, size-s, $O(\log s)$-variate constant-width ROABPs. We also show that we can work with unbounded-many such ROABPs if each ROABP computes a homogeneous polynomial. We introduce two new techniques, both of which also work for the border version of the stated models. (1) The leading-degree-part of an ROABP can be made syntactically homogeneous in the same width. (2) There is a direct reduction from PIT of sum-of-ROABPs to PIT of single ROABP.

4. **High-Level Support Activities of Simulation Laboratory E&A Particles** (link)
with G. Poghosyan, S. Sharma, A. Kaur, V. Jindal, A. Streit, M. Bejger, A. Królak, T. Klaehn, S. Typel, J. Oehlschläger, T. Pierog, R. Engel.
High Performance Computing in Science and Engineering 2014

This paper was a findings report of a large collaborative project that was tasked with parallelisation, performance analysis of scalability, efficiency and estimation of potential consumption of CPU time for the codes CORSIKA (for simulation of cosmic rays/air showers). My part in the project was to develop MPI task farmer scheduling mechanisms for this data intensive, massively parallel simulations of air showers. Specifically, I developed code to optimize input/output data handling of CORSIKA and analyzed its run-time.