

Curriculum Vitae

Surender Baswana

Professor
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Research Interest

Design and analysis of computer algorithms, especially, Graph algorithms, Dynamic algorithms, Streaming algorithms, Randomized algorithms.

Education

Degree	Institute	Department	Year
Bachelor of Technology	Indian Institute of Technology Delhi	Comp. Sc. and Engg.	1997
Master of Technology	Indian Institute of Technology Delhi	Comp. Sc. and Engg.	1999
PhD	Indian Institute of Technology Delhi	Comp. Sc. and Engg.	2005

Important Note: PhD thesis was submitted in October 2003, but the thesis defence could be held in July 2005 due to delay in the reports of the examiners. So the PhD degree could be awarded only in August 2005.

Employment

Professor (August 2016 - onwards) Deptt. of Comp. Sc. & Engg., I.I.T. Kanpur.
Associate Professor (December 2010 - July 2016) Deptt. of Comp. Sc. & Engg., I.I.T. Kanpur.
Assistant Professor (July 2006-November 2010) Deptt. of Comp. Sc. & Engg., I.I.T. Kanpur.
Postdoctoral Researcher (October 2003- June 2006)
Max. Planck Institute of Computer Science
Algorithms & Complexity group,
Saarbruecken, Germany.

Refereed Journal Articles

- J1.** S. Baswana, P. P. Chakrabarti, S. Chandran, Y. Kanoria, and U. Patange: Centralized Admissions for Engineering Colleges in India. *Interfaces*, 49(5): 338-354, 2019 (A special issue for **the finalists for the 2018 Daniel H. Wagner Prize** for Excellence in Operations Research Practice).
- J2.** S. Baswana, S. R. Chaudhury, K. Choudhary, and S. Khan. Dynamic DFS tree in undirected graphs: Breaking the $O(m)$ barrier. *SIAM Journal on Computing*, 48(4), 1335-1363, 2019.
- J3.** S. Baswana, K. Choudhary, L. Roditty: An Efficient Strongly Connected Components Algorithm in the Fault Tolerant Model. *Algorithmica* 81(3), 967-985, 2019.
- J4.** S. Baswana, M. Gupta, S. Sen: Fully dynamic maximal matching in $O(\log n)$ update time (corrected version). *SIAM Journal on Computing*, 47(3), 617-650, 2018.
DOI: <https://epubs.siam.org/doi/abs/10.1137/16M1106158>.
- J5.** S. Baswana, K. Choudhary, L. Roditty: Fault tolerant reachability subgraph - Generic and optimal. *SIAM Journal on Computing* 47(1), 80-95, 2018.
- J6.** S. Baswana, S. Khan: Incremental algorithm for DFS tree in undirected graphs. *Algorithmica*. 79(2), 466-483, 2017.
- J7.** S. Baswana and N. Khanna. Approximate shortest paths avoiding a failed vertex: Near optimal data structures for undirected unweighted graphs. *Algorithmica* 66(1), 18-50, 2013.
- J8.** S. Baswana, S. Khurana, and S. Sarkar. Fully Dynamic Algorithms for Graph Spanners. *ACM Transactions on Algorithms* 8(4):35, 2012.
- J9.** S. Baswana and T. Kavitha. Faster Algorithms for All-Pairs Approximate Shortest Paths in Undirected Graphs. *SIAM Journal of Computing* 39(7), 2865-2896, 2010.
- J10.** S. Baswana and T. Kavitha, K. Mehlhorn, and S. Pettie. Additive Spanners and (α, β) -Spanners. *ACM Transactions on Algorithms* 7(1): 5, 2010.
- J11.** S. Baswana and V. Goyal and S. Sen. All-Pairs Nearly 2-Approximate Shortest Paths in $O(n^2 \text{ polylog } n)$ time. *Theoretical Computer Science* 410, 84-93, 2009.
This paper was **among the selected best papers** of *STACS 2005* conference and was invited for publication in a special issue of the journal *Theory of Computing System*.
- J12.** S. Baswana. Streaming algorithm for graph spanners - single pass and constant processing time per edge. *Information Processing Letters* 106(3), 110-114, 2008.
- J13.** S. Baswana and S. Sen. A Simple Linear Time Randomized Algorithm for Computing Sparse Spanners in Weighted Graphs. *Random Structures and Algorithms* 30(4), 532-563, 2007.
This paper was **among the selected best papers** of *ICALP 2003* conference and was invited for publication in a special issue of the journal *Theoretical Computer Science*.
- J14.** S. Baswana and R. Hariharan and S. Sen. Improved Decremental Algorithms for Maintaining Transitive Closure and All-pairs Shortest Paths in Digraphs. *Journal of Algorithms* 62(2), 74-92, 2007.
- J15.** S. Baswana and S. Sen. Approximate Distance Oracles for Unweighted graphs in $O(n^2)$ time. *ACM Transactions on Algorithms* 2(4), 557-577, 2006.
This paper was **among the selected best papers** of *SODA 2004* conference and was invited for publication in a special issue of this journal.
- J16.** S. Baswana and S. Sen. Planar Graph Blocking for External Searching. *Algorithmica* 34, 298-308, 2002.

Refereed Conference Proceedings

- C1.** S. Baswana, S. Gupta, T. Knollmann: Mincut Sensitivity Data Structures for the Insertion of an Edge. *Proc. 28th European Symposium on Algorithms (ESA)*, 12:1-12:14, 2020.
- C2.** S. Baswana, S. Gupta, and A. Tulsyan: Fault Tolerant and Fully Dynamic DFS in Undirected Graphs: Simple Yet Efficient. *Proc. 44th International Symposium on Mathematical Foundations of Computer Science (MFCS)*, 65:1-65:16, 2019.
- C3.** S. Baswana, P. P. Chakrabarti, S. Chandran, Y. Kanoria, and U. Patange: Centralized Admissions for Engineering Colleges in India. *Proc. 20th ACM conference on Economics and Computation (EC)*, 323-324, 2019.
- C4.** S. Baswana, K. Choudhary, M. Hussain, and L. Roditty. Approximate Single Source Fault Tolerant Shortest Path. *Proc. 29th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 1901-1915, 2018.
- C5.** S. Baswana, A. Goel, and S. Khan. Incremental DFS algorithms: a theoretical and experimental study. *Proc. 29th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 53-72, 2018.
- C6.** S. Baswana, K. Choudhary, L. Roditty. An efficient strongly connected components algorithm in fault tolerant model. *Proc. 44th International Colloquium on Automata, Languages and Programming (ICALP)*, Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, 72:1-72:15, 2017.
- C7.** S. Baswana, K. Choudhary, L. Roditty. Fault tolerant subgraph for single source reachability: generic and optimal. *Proc. 48th ACM Symposium on Theory of Computing (STOC)*, 509-518, ACM, 2016.
- C8.** S. Baswana, S. R. Chaudhury, K. Choudhary, and S. Khan. Dynamic DFS tree in undirected graphs: Breaking the $O(m)$ barrier. *Proc. 27th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 730-739, 2016.
- C9.** S. Baswana. Randomization for Efficient Dynamic Graph Algorithms. *Proc. 2nd International Conference on Algorithms and Discrete Applied Mathematics (CALDAM)*, 1-13, 2016.
- C10.** S. Baswana, K. Choudhary, and L. Roditty. Fault tolerant reachability for directed graphs. *Proc. 29th International Symposium on Distributed Computing (DISC)*, Springer-Verlag, Lecture Notes in Computer Science, Lecture Notes in Computer Science, volume 9363, 528-543, 2015.
- C11.** S. Baswana and K. Choudhary. On dynamic DFS tree in directed graphs. *Proc. 40th International Symposium on Mathematical Foundations of Computer Science (MFCS)*, Springer-Verlag, Lecture Notes in Computer Science, volume 9325, 102-114, 2015.
- C12.** S. Baswana and S. Khan. Incremental algorithm for maintaining DFS tree for undirected graph. *Proc. 41st International Colloquium on Automata, Languages and Programming (ICALP)*, Springer-Verlag, Lecture Notes in Computer Science, volume 8572, 136-149, 2014.
- C13.** R. Chouhan, S. Roy, S. Baswana: Pertinent path profiling: Tracking interactions among relevant statements. *Proc. of the 2013 IEEE/ACM International Symposium on Code Generation and Optimization, (CGO)*, 1-12, 2013.
- C14.** S. Baswana, U. Lath, and A. Mehta. Single source distance oracle for planar digraphs avoiding any failed node or link. *Proc. 23rd ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 223-232, 2012.
- C15.** A. Anand, S. Baswana, M. Gupta, and S. Sen. Maintaining approximate maximum weighted matching in fully dynamic graphs. *Proc. 32nd Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS)*, 257-266, 2012.

- C16.** S. Baswana, M. Gupta, and S. Sen. Fully dynamic maximal matching in $O(\log n)$ update time. *Proc. 52nd IEEE Symposium on Foundations of Computer Science (FOCS)*, 383-392, 2011.
- C17.** N. Khanna and S. Baswana. Approximate shortest paths under single vertex failure : Optimal size data structures for unweighted graphs. *Proc. 27th International Symposium on Theoretical Aspects of Computer Science (STACS)*, 513-524, 2010.
- C18.** S. Baswana, S. Biswas, B. Doerr, T. Friedrich, P.P. Kurur, and F. Neumann. Computing Single Source Shortest Paths using Single-Objective Fitness Functions. *Proc. 10th ACM Symposium on Foundations of Genetic Algorithms*, Orlando, Florida, USA, January 9-11, 2009.
- C19.** S. Baswana, A. Gaur, S. Sen, and J. Upadhyay. Distance oracles for unweighted graphs : breaking the quadratic barrier with constant additive error. *Proc. 35th International Colloquium on Automata, Languages and Programming (ICALP)*, Springer-Verlag, Lecture Notes in Computer Science, volume 5125, 609-621, 2008.
- C20.** S. Baswana and S. Sarkar. Fully Dynamic Polylogarithmic Algorithms for Graph Spanners. *Proc. 19th Symposium on Discrete Algorithms (SODA)*, 672-681. ACM and SIAM, 2008.
- C21.** S. Baswana, S. Mehta and V. Powar. Implied Set Closure and Its Application to Memory Consistency Verification. *Proc. 20th International Conference on Computer Aided Verification (CAV)*, Springer-Verlag, Lecture Notes in Computer Science, volume 5123, 94-106, 2008.
- C22.** S. Baswana and T. Kavitha. Faster Construction of Approximate Distance Oracles and All-Pairs Small Stretch Paths. *Proc. 47th Symposium on Foundations of Computer Science (FOCS)*, 591-602. IEEE, 2006.
- C23.** S. Baswana. Dynamic Algorithms for Graph Spanners. *Proc. 14th European Symposium on Algorithms (ESA)*, Springer-Verlag, Lecture Notes in Computer Science, volume 4168, 76-87, 2006.
- C24.** S. Baswana, T. Kavitha, K. Mehlhorn, and S. Pettie. New Constructions of (α, β) -Spanners and Purely Additive Spanners. *Proc. 16th Symposium on Discrete Algorithms (SODA)*, 672-681. ACM and SIAM, 2005.
- C25.** S. Baswana, V. Goyal, and S. Sen. All-pairs nearly 2-approximate shortest paths in $O(n^2 \text{polylog} n)$ time. *Proc. 22nd International Symposium on Theoretical Aspects of Computer Science (STACS)*, Springer-Verlag, Lecture Notes in Computer Science, volume 3404, 666-679, 2005. This paper was **among the selected best papers** of the conference and was invited for publication in a special issue of the journal *Theory of Computing Systems*.
- C26.** S. Baswana and S. Sen. Approximate Distance Oracles for Unweighted graphs in $O(n^2 \log n)$ time. *Proc. 15th Symposium on Discrete Algorithms (SODA)*, 264-273, ACM and SIAM, 2004. This paper was **among the selected best papers** of the conference and was invited for publication in a special issue of the journal *ACM Transaction on Algorithms*.
- C27.** S. Baswana and S. Sen. A Simple Linear Time Algorithm for Computing $(2k - 1)$ -Spanners of size $O(kn^{1+1/k})$ in Weighted Graphs. *Proc. 30th International Colloquium on Automata, Languages and Programming (ICALP)*, Springer-Verlag, Lecture Notes in Computer Science, volume 2719, 384-396, 2003. This paper was **among the selected best papers** of the conference and was invited for publication in a special issue of the journal *Theoretical Computer Science*.
- C28.** S. Baswana, R. Hariharan, and S. Sen. Maintaining All-Pairs Approximate Shortest Paths Under Deletion of Edges. *Proc. 14th Symposium on Discrete Algorithms (SODA)*, 394-403. ACM and SIAM, 2003.
- C20.** S. Baswana, R. Hariharan, and S. Sen. Improved Decremental Algorithms for Maintaining Transitive Closure and All-pairs Shortest Paths in Digraphs. *Proc. 34th ACM Symposium on Theory of Computing (STOC)*, 117-123, ACM, 2002.

- C30.** S. Baswana and S. Sen. Planar Graph Blocking for External Searching. *Proc. 20th Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS)*, Springer-Verlag, Lecture Notes in Computer Science 1974, 252-263, 2000.

Book Chapters

- B1.** S. Baswana and S. Sen. Randomized graph algorithms: Techniques and analysis. *Handbook of Graph Algorithms and Applications*, ISBN 9781584885979. Krishnaiyan Thulasiraman, Arun Kumar Somani, Sarma Vrudhula (Ed.), CRC Press, 2016.
- B2.** S. Baswana, M. Gupta, and S. Sen. Matching in Dynamic Graphs. *Encyclopedia of Algorithms*. Ming Yang Kao (Ed.), Springer, Online ISBN 9783642278488, DOI 10.1007/978-3-642-27848-8_10-2, 2015.
- B3.** S. Baswana and S. Sen. Randomized graph data-structures for approximate shortest path problem. *Handbook of Data Structures and Applications*, ISBN 1584884355. Dinesh Mehta and Sartaj Sahni (Ed.), CRC Press, 2004.
- B4.** S. Baswana and S. Sen. Simple Algorithms for Spanners in Weighted Graphs. *Encyclopedia of Algorithms*. Ming Yang Kao (Ed.), Springer, Online ISBN 9780387301624, DOI 10.1007/978-0-387-30162-4_10, 2008.

PhD supervision

1. Manoj Gupta [2009 - 2014] (jointly supervised by me and Prof. Sandeep Sen at IIT Delhi)
Currently Assistant Professor at IIT Gandhinagar.
2. Keerti Choudhary [2013 - 2017]
Currently a Postdoctoral Researcher at Weizmann Institute of Science in Israel.
3. Shahbaz Khan [2013 - 2017]
Currently a Postdoctoral researcher at University of Helsinki, Finland.

MTech supervision A total of **18** MTech thesis have been supervised.

Sponsored Projects

1. Title of the project: Dynamic Graph Algorithms
Duration: October 2014-September 2017
Sponsors: University Grants Commission (UGC) of India and Israel Science Foundation
Funding Amount: INR 38,40,000. (Approx. 60,000 US Dollars)

Professional Services

- *Joint Seat Allocation for Centrally Funded Technical Institutes* Until 2014, the admissions to the Indian Institutes of Technology (IITs) were conducted under one umbrella, whereas the admissions to the non-IIT Central Government Funded Technical Institutes (GFTIs) were conducted under a separate umbrella by the Central Seat Allocation Board (CSAB). The same candidates were eligible to apply for a seat in each of the two sets of institutes, and several hundred candidates would indeed receive two seats each. Each such candidate could use at most one of the seats, leaving a vacancy in the other seat, which would be noticed much later, in many cases after classes begin. Such seats would either remain vacant or would be reallocated at a later stage, leading to inefficiency in seat allocation in the form of unnecessary vacancies, and also misallocation of seats (e.g. a particular CSAB seat could later be offered during a spot round to a candidate A with a worse rank, which was previously denied to a candidate B with better rank, who meanwhile took up some IIT seat).

Since 2015, a new combined seat allocation process has been implemented to resolve this issue. The process brought all Government Funded Technical Institutes under one umbrella for admissions. Each candidate submitted a single preference/choice list over all available programs, and received no more than a single seat from the system, based on their choices and their ranks in the relevant merit lists. At the core of this seat allocation process lies the stable-marriage algorithm invented by Gale and Shapley in 1962. A technical committee was constituted with the objective to adapt this algorithm to various business rules of admissions in these institutes and to engineer it to handle many practical challenges. Some of these business rules were quite non-trivial from algorithmic perspective. The committee, headed by Prof. P. P. Chakrabarti (Director, IIT Kharagpur), consisted of Surender Baswana (IIT Kanpur), Sharat Chandran (IIT Bombay), Yashodhan Kanoria (Columbia Business School).

Transforming the algorithm into a software was also challenging. There was no scope of an error since even a single wrong allocation of seat could be catastrophic – the future of thousands of candidates was at a stake. Considering the criticality of the task, for the first 4 years (2015-2018), the joint seat allocation was carried out using two softwares designed independently by IITK and NIC. In each of these years, the IITK software proved to be indispensable on various occasions of the joint seat allocation.

The technical paper “Centralized Admissions for Engineering Colleges in India” that addresses the novelty of the entire joint seat allocation process along with its impact was one of the six finalists for the Wagner Prize for Excellence in Operations Research Practice in 2018. This technical paper appeared in a special issue of the journal *Interfaces* in 2019 (earlier known as *INFORMS Journal on Applied Analytics*). Its succinct version also appeared in the Proceedings of the 20th ACM conference on Economics and Computation (ACM EC '19).

- *Chair (Local Organization) CALDAM 2015*
Served a Chair of the Local Organization for the 1st International Conference on Algorithms and Discrete Applied Mathematics held at IIT Kanpur from 8th February to 10th February, 2015.
- *Programme Committee member FSTTCS 2012*
Served as a PC member for 32nd Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS) to be held from December 15-17, 2012 at Hyderabad, India.
- *Programme Committee member ICALP 2005*
Served as a PC member (Algorithms track) for 32nd International Colloquium on Automata, Languages and Programming (ICALP) held on July 11-15, 2005 at Lisboa, Portugal.

Awards and Achievements

Research:

- The Finalist for the Wagner Prize for Excellence in Operations Research Practice in 2018 for the technical paper “Centralized Admissions for Engineering Colleges in India” that is going to appear in a special issue of *INFORMS Journal on Applied Analytics*.
- Recipient of the Alexander von Humboldt Fellowship for Experience Researchers in 2018.
- Received certificate of exceptional contribution from the Director of IIT Bombay (Chairman JAB 2015) towards the development of the software for the joint seat allocation in central government funded technical institutes of India in 2015.
- *Young Engineer Award*
Received Young Engineer Award from Indian National Academy of Engineering for the year 2009.
- *Research I Fellow*
Received Research I Fellowship for years 2007-2010 by Research I Foundation, Department of Computer Science and Engineering, IIT Kanpur.
- *Outstanding Ph.D. Dissertation Award*
Received Outstanding Ph.D. Dissertation Award by IBM India Research Lab in 2005.
- *Award for commendable research*
Received award for commendable research work in Inter Research Institute Students Seminar (IRISS) held in I.I.T. Delhi, March 28-29, 2003.

Teaching :

- *IIT Kanpur Distinguished Teacher Award* for the year 2017.
- *Gopal Das Bhandari Memorial Distinguished Teacher award* by the graduating batch of the year 2010 across all disciplines in IIT Kanpur.
- *Best Faculty Award* by the graduating batch of the Department of Comp. Sc. & Engg., IIT Kanpur for the years 2010, 2011, 2012, 2013, 2015, 2017, and 2018.

Personal Data

Date of Birth : August 26, 1974

Nationality : Indian

Sex : Male

Marital Status : Married