Curriculum Vitae

Surender Baswana

Professor
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Research Interest

Design and analysis of Graph algorithms, especially, Dynamic algorithms, Fault-tolerant data structures, 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[1]

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.

Software Engineer (February 1999 - December 1999)
Lucent Technologies, Bangalore.

Refereed Journal Articles

J1. S. Baswana, K. Bhanja, and A. Pandey: Minimum+1 (s,t)-cuts and Dual-edge Sensitivity Oracle. *ACM Transactions on Algorithms*, 19(4): 38:1-38:41 2023.

J2. S. Baswana, S. Gupta, and T. Knollmann: Mincut Sensitivity Data Structures for the Insertion of an Edge. *Algorithmica*. 84(9): 2702-2734, 2022.

J3. S. Baswana, S. Gupta, and A. Tulsyan: Fault Tolerant Depth First Search in Undirected Graphs: Simple Yet Efficient. *Algorithmica*. 84(7): 2028-2049, 2022.

J4. S. Baswana, K. Choudhary, M. Hussain, L. Roditty: Approximate Single-Source Fault Tolerant Shortest Path. *ACM Transactions on Algorithms*, 16(4), 44:1-44:22, 2020.

J5. S. Baswana, P. P. Chakrabarti, S. Chandran, Y. Kanoria, and U. Patange: Centralized Admissions for Engineering Colleges in India. *INFORMS Journal of Applied Analytics*, 49(5): 338-354, 2019 (A special issue for **the finalists for the 2018 Daniel H. Wagner Prize** for Excellence in Operations Research Practice).

J6. 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.

J7. S. Baswana, K. Choudhary, L. Roditty: An Efficient Strongly Connected Components Algorithm in the Fault Tolerant Model. *Algorithmica* 81(3), 967-985, 2019.

J8. 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.

J9. S. Baswana, K. Choudhary, L. Roditty: Fault tolerant reachability subgraph - Generic and optimal. *SIAM Journal on Computing* 47(1), 80-95, 2018.

J10. S. Baswana, S. Khan: Incremental algorithm for DFS tree in undirected graphs. *Algorithmica.* 79(2), 466-483, 2017.

J11. 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.

J12. S. Baswana, S. Khurana, and S. Sarkar. Fully Dynamic Algorithms for Graph Spanners. *ACM Transactions on Algorithms* 8(4):35, 2012.

J13. 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.

J14. S. Baswana and T. Kavitha, K. Mehlhorn, and S. Pettie. Additive Spanners and (α, β)-Spanners. *ACM Transactions on Algorithms* 7(1): 5, 2010.

J15. S. Baswana and V.Goyal and S. Sen. All-Pairs Nearly 2-Approximate Shortest Paths in $O(n^2 \operatorname{polylog} n)$ 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.*

J16. S. Baswana. Streaming algorithm for graph spanners - single pass and constant processing time per edge. *Information Processing Letters* 106(3), 110-114, 2008.

J17. 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.*

J18. 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.

J19. 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.

J20. S. Baswana and S. Sen. Planar Graph Blocking for External Searching. *Algorithmica* 34, 298-308, 2002.

Refereed Conference Proceedings

C1. S. Baswana and A. Pandey: The connectivity carcass of a vertex subset in a graph: both odd and even case. *Proc. 8th SIAM Symposium on Simplicity in Algorithms (SOSA)*, 385–422, 2025.

C2. S. Baswana and K. Bhanja: Vital Edges for (s,t)-Mincut: Efficient Algorithms, Compact Structures, & Optimal Sensitivity Oracles. *Proc. 52nd International Colloquium on Automata, Languages, and Programming (ICALP)*, 17:1-17:20, 2024.

C3. S. Baswana and A. Pandey: Sensitivity Oracles for All-Pairs Mincuts. *Proc. 33rd ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 581-609. 2022.

C4. S. Baswana, K. Bhanja, A. Pandey: Minimum+1 (s, t)-cuts and Dual Edge Sensitivity Oracle. *Proc. 50th International Colloquium on Automata, Languages, and Programming (ICALP)*, 15:1-15:20, 2022.

C5. 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.

C6. 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.

C7. 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.

C8. 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.

C9. 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.

C10. 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.

C11. 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.

C12. 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.

C13. S. Baswana. Randomization for Efficient Dynamic Graph Algorithms. *Proc. 2nd International Conference on Algorithms and Discrete Applied Mathematics (CALDAM)*, 1-13, 2016.

C14. 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.

C15. 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.

C16. 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.

C17. 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.

C18. 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.

C18. 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.

C20. 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.

C21. 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.

C22. 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.

C23. 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.

C24. 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.

C25. 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.

C26. 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.

C27. 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.

C28. 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.

C29. S. Baswana, V. Goyal, and S. Sen. All-pairs nearly 2-approximate shortest paths in $O(n^2 polylogn)$ 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.*

C30. 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 one of the 11 **selected best papers** (judged by the PC) among 117 papers that were accepted in the conference, and was invited for publication in a special issue of the journal *ACM Transaction on Algorithms.*

C31. *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.

C32. *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.*

C33. *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.*

C34. *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 with Prof. Sandeep Sen at IIT Delhi)
   Currently a faculty member at IIT Gandhinagar.
2. Keerti Choudhary [2013 - 2017] (**ACM India Doctoral Dissertation Awardee 2019**)
   Currently a faculty member at IIT Delhi.
3. Shahbaz Khan [2013 - 2017]
   Currently a faculty member at IIT Roorkee.
4. Koustav Bhanja [2020 - 2014] (**Manas Mandal Best PhD thesis award by the Department of CSE, IIT Kanpur**)
   Currently a Postdoctoral fellow at Weizmann Institute of Science.
5. Anupam Roy [2023 -]

MTech supervision A total of **19** 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* Indian Institutes of Technology (IITs) are known globally for their excellence in technical education, research, and innovation. These institutes have also arguably the most competitive process for admitting students at undergraduate level : out of the 1.2 million annual applicants, only less than 1 percent are admitted. However, it was very puzzling and frustrating that, until 2015, about 600 available seats at the IITs were consistently unfilled annually. One key reason for seats remaining vacant was as follows. From the 1960s to 2014, the admissions to IITs were conducted under one umbrella. Only slightly less sought after than the IITs are the non-IIT Centrally Funded Technical Institutes (CFTIs). The admissions to the non-IIT CFTIs were conducted under a separate umbrella, after completion of the IIT admissions. Each candidate was eligible to apply for a seat in each of the two sets of institutes, and several hundred candidates would indeed receive two offers, one at an IIT, and later, another one at a non-IIT. Each such candidate could use at most one of the seats, leaving a vacancy in the other seat.

  In 2015, a joint seat allocation process based on the Deferred Acceptance (DA) algorithm of (Gale and Shapley 1962) was designed. This process brings all the over 80 CFTIs (IITs + non-IITs) under one umbrella for admissions. Each candidate submits a single preference list over all available programs, and receives no more than a single seat from the system, based on her submitted preferences and her rank in each relevant Merit List.

  Though the DA algorithm looks simple and easy in theory, the joint seat allocation had to address various challenges. First challenge was that the seat allocation must incorporate complex rules regarding multiple types of seat reservations for affirmative action. In addition, it is not permitted, in anticipation of attrition, to speculatively admit more students than the capacity. Finally, despite complexities, the process is required to be completely transparent (unlike many other college admissions mechanisms worldwide).

  The joint seat allocation process addressed all these challenges and has, since 2015, provably reduced vacancies at the IITs by nearly **three-fourths**.
  I was a member of the Technical Committee set up by MHRD to incorporate complex business rules of admissions in the DA algorithm for the joint seat allocation. For the first 4 years [2015-18], the software developed by our team at IIT Kanpur was actually used for the joint seat allocation. The Technical Committee also carried out various novel experiments on the efficacy of the joint seat allocation for the first 4 years. These results appeared in a research paper in the journal *Interfaces* in 2019. Refer to the Publications section for more details.

- *Programme Committee member ICALP 2005*
  Served as a PC member (Algorithms track) for 32nd International Colloquium on Automata, Languages and Programming (ICALP) held during July 11-15, 2005 at Lisboa, Portugal.

- *Programme Committee member FSTTCS 2012*
  Served as a PC member for 32nd Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS) held during December 15-17, 2012 at Hyderabad, India.

- *Programme Committee member ESA 2022*
  Served as a PC member (Algorithms track) for 30th European Symposium on Algorithms held during September 5-9, 2022, Berlin, Potsdam, Germany.

- *Programme Committee member SODA 2026*
  To serve as a PC member for the 37th ACM-SIAM Symposium on Discrete Algorithms to be held during January 11–14, 2026, Vancouver, Canada.

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 has appeared in a special issue of *INFORMS Journal on Applied Analytics, 2019*.

- 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, 2018, and 2024.

Personal Data

Date of Birth : August 26, 1974
Nationality : Indian
Sex : Male
Marital Status : Married