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BIODATA

- **Qualifications**
  - Ph.D. in Computer Science & Engineering, IIT Bombay (1995).
    Title of the thesis : *A Generalised Theory of Bit Vector Data Flow Analysis*.
  - M.Tech. in Computer Science from Department of Computer Science, University of Pune (1989).
  - B.E. in Electronics & Telecommunication Engineering from Government Engineering College, Jabalpur (1986).
  - H.S.S.C. from M. P. Board of Secondary Education with (1981).
- **Areas of Interests**
  - Programming Languages and Compilers, Program Analysis.
- **Experience**
  - Department of Computer Science, University of Pune. Lecturer (1994-1995), Reader (1995-2001).
  - Department of Computer Science and Engineering, IIT Bombay. Assistant Professor (2001-2003), Associate Professor (2003 to 2009), Professor (since 2009).
    Currently, Head of the department (for a three year term).
- **Honours and Distinctions**
  - IBM Faculty Award 2007.

TEACHING AND RESEARCH

- **Courses Taught**

  Have taught the following regular courses: Design and Implementation of Gnu Compiler Generation Framework, Program Analysis, Compiler Construction, Advanced Compilers, Advanced Data Flow Analaysis (at University of Cambridge, UK), Systems Programming, Software Laboratory, Programming Paradigms, Introduction to Programming etc.

  Have also taught courses to the industry based on their specific needs. Have organized one week courses on compiler construction for college teachers and workshops on GCC for industry and academia.

- **Research Areas**

  Have been working in the area of optimising compilers for over two decades. Current sub-areas of interest include Interprocedural Data Flow Analysis, Heap Reference Analysis, Pointer Analysis, Automatic Parallelization and Vectorization, and Compiler Verification.

- **GCC Resource Center**.

  We have set up GCC Resource Center (`http://www.cse.iitb.ac.in/grc`) to explain our findings to GCC community. This center was funded by the Department of Electronics and Information Technology, Ministry of Communication and Information Technology, Government of India.

  With our studies, we have been able to bring down the ramp up period in GCC internals from six months to less than a month. Three important research goals in GCC are (a) To support automatic construction of machine dependent optimizers, (b) To suppport flow and context sensitive pointer analysis, and (c) to simplify the machine descriptions.

  We have conducted workshops on *Essential Abstractions in GCC* for training participants in GCC internals. The workshops included lectures as well as programming assignments. Our latest training material can be found at
  `http://www.cse.iitb.ac.in/grc/gcc-workshop-13/index.php?page=slides`.

- **Publications**

  – ***Books***

    Uday P. Khedker, Amitabha Sanyal, and Bageshri Karkare. *Data Flow Analysis: Theory and Practice.* CRC Press, USA, 2009.

    Teaching material accompanying this book can be found at the book page:
    `http://www.cse.iitb.ac.in/~uday/dfaBook-web/`.

    An Indian edition of this book has been published by Ane books in 2013.

  – ***Book Chapters***

    1. Amitabha Sanyal and Uday P. Khedker. *Garbage Collection Techniques.* In "The Compiler Design Handbook : Optimizations & Machine Code Generation." (2nd Ed.) CRC Press USA. 2007.
    2. Uday P. Khedker. *Data Flow Analysis.* In "The Compiler Design Handbook : Optimizations & Machine Code Generation." (1st Ed.) CRC Press USA. 2002.

  – ***Journal Papers***

    1. Vini Kanvar, Uday P. Khedker. *Heap Abstractions for Static Analysis*. ACM Computing Surveys. 49(2): 29:1-29:47 (2016).
    2. Benjamin Livshits, Manu Sridharan, Yannis Smaragdakis, Ondrej Lhotk, Jos Nelson Amaral, Bor-Yuh Evan Chang, Samuel Z. Guyer, Uday P. Khedker, Anders Mller, Dimitrios Vardoulakis. *In Defense of Soundiness: A Manifesto*. Communications of ACM 58(2): 44-46 (2015).
    3. Aditya Kanade, Amitabha Sanyal, and Uday P. Khedker. *Validation of GCC optimizers through trace generation.* Software Practice and Experience 39(6): 611-639 (2009).
    4. Uday P. Khedker, Amitabha Sanyal, and Amey Karkare. *Heap reference analysis using access graphs.* ACM Transactions on Programming Languages & Systems. Vol. 30, Issue 1 (Nov. 2007).

5. Bageshri Sathe and Uday P. Khedker. *An improved bound for call-Strings based interprocedural data flow analysis.* ACM Transactions on Programming Languages & Systems. Vol. 29, Issue 6 (Oct. 2007).
6. Uday P. Khedker, D. M. Dhamdhere, and Alan Mycroft. *Bidirectional data flow analysis for type inferencing.* Computer Languages, 29(1-2), Pages 15-44, 2003.
7. Rahul Joshi, Uday P. Khedker, Vinay Kakade, and Medha Trivedi. *Some interesting results about applications of graphs in compilers.* CSI Journal, 31(4), 2002.
8. Uday P. Khedker and D. M. Dhamdhere. *Bidirectional data flow analysis: Myths and reality.* SIGPLAN Notices, June 1999.
9. Uday P. Khedker and D. M. Dhamdhere. *A generalized theory of bit vector data flow analysis*. ACM Transactions on Programming Languages & Systems, 16(5):1472–1511, 1994.

– ***Conference and Workshop Papers***

1. Pritam M. Gharat, Uday P. Khedker, Alan Mycroft. *Flow and Context Sensitive Points-to Analysis using Generalized Points-to Graphs*. International Static Analysis Symposium (SAS 2016). UK 2016.
2. Tukaram Muske, Uday P. Khedker. *Cause Points Analysis for Effective Handling of Alarms.* ISSRE International Symposium on Software Reliability Engineering (ISSRE) 2016: 173-184.
3. Tukaram Muske, Uday P. Khedker. *Efficient Elimination of False Positives Using Static Analysis*. International Symposium on Software Reliability Engineering (ISSRE) 2015: 270-280.
4. Shrawan Kumar, Amitabha Sanyal, Uday P. Khedker. *Value Slice: A New Slicing Concept for Scalable Property Checking*. International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 2015: 101-115.
5. Rohan Padhye and Uday P. Khedker. *Interprocedural Data Flow Analysis in Soot using Value Contexts.* ACM SIGPLAN International Workshop on the State Of the Art in Java Program Analysis (SOAP 2013). Seattle, USA.
   The resulting tool is called VASCO and is available for download from the following URL `https://github.com/rohanpadhye/vasco`.
6. Uday P. Khedker, Alan Mycroft, and Prashant Singh Rawat. *Liveness Based Pointer Analysis.* International Static Analysis Symposium (SAS 2012). France 2012.
   An GCC based implementation called LFCPA is available for download from the following URL `http://www.cse.iitb.ac.in/grc/index.php?page=l-fcpa`.
7. Uday P. Khedker and Ankita Mathur. *specRTL: A language for GCC Machine Descriptions.* 3rd International Workshop on GCC Research Opportunities (GROW 2011). Chamonix, France.
   An initial version of the implementation is available for download from the following URL `http://www.cse.iitb.ac.in/grc/index.php?page=specRTL`. Revised implementations will be available at the same URL.
8. Rupesh Nasre, Kaushik Ranjan, R. Govindrajan, and Uday P. Khedker. *Scalable context-sensitive points-to analysis using multi-dimensional bloom filters.* Asian Symposium on Programming Languages and Symposium (APLAS 2009). Korea.
9. Uday Khedker and Bageshri Sathe. *Efficiency, precision, simplicity, and generality in interprocedural data flow analysis: resurrecting the classical call strings method*. International Conference on Compiler Construction (CC 2008), Budapest, Hungary.

10. Sameera Deshpande and Uday P. Khedker. *Incremental machine descriptions for GCC.* International Workshop on GCC for Research in Embedded Parallel Systems (GREPS'07) held in conjunction with International Conference on Parallel Architectures and Compilation Techniques (PACT 2007). Brasov, Romania.
11. Amey Karkare, Uday P. Khedker and Amitabha Sanyal. *Liveness of heap data for functional programs,* Heap Analysis and Verification Workshop. In the European joint conferences on Theory And Practice of Software (ETAPS'07), Vienna, Austria.
12. Aditya Kanade, Amitabha Sanyal, and Uday P. Khedker. *A PVS based framework for validating compiler optimizations.* The 4th IEEE International Conference on Software Engineering and Formal Methods (SEFM'06), Pune, India, 2006.
13. Bageshri Sathe and Uday P. Khedker. *Complexity of data flow analysis for non-separable frameworks.* The 2006 International Conference on Programming Languages and Compilers (PLC'06), 2006, Las Vegas, USA.
14. Bageshri Sathe and Uday P. Khedker. *Static Program partitioning for embedded processors.* The 2006 International Conference on Embedded Systems and Applications. (ESA'06), 2006, Las Vegas, USA.
15. Aditya Kanade, Amitabha Sanyal, and Uday P. Khedker. *Structuring optimizing transformations and proving them sound.* The 5th International Workshop on Compiler Optimization meets Compiler Verification (COCV'06), Pages 105-121. In the European joint conferences on Theory And Practice of Software (ETAPS'06), Vienna, Austria.
16. Aditya Kanade, Uday P. Khedker and Amitabha Sanyal. *Heterogeneous fixed points with applications to points-to analysis.* 3rd Asian Symposium on Programming Languages and Systems (ASPLAS'05), Tsukuba, Japan, 2005. Volume 3780 of Lecture Notes in Computer Science, Springer-Verlag.
17. Uday P. Khedker and R. Govindarajan. *Compiler analysis and optimizations : What is new?* Invited paper. Proceedings of the Workshop on Cutting Edge Computing (New Frontiers in High Performance Computing). Pages 59-69. International Conference on High Performance Computing (HiPC03), Hyderabad, 2003.
18. D. M. Dhamdhere and Uday P. Khedker. *Complexity of bidirectional data flow analysis*. In Proceedings of the 20^{th} Annual ACM SIGACT/SIGPLAN Symposium on Principles of Programming Languages, Charleston, South Carolina, (USA), 1993.

– ***Miscellaneous Papers***

1. Aditya Kanade, Amitabha Sanyal, Uday P. Khedker. *A Logic for Correlating Temporal Properties across Program Transformations*. ACM Computing Research Repository CoRR abs/1209.5152, 2012.
2. Amey Karkare, Amitabha Sanyal, and Uday P. Khedker. *Effectiveness of garbage collection in MIT/GNU Scheme.* ACM Computing Research Repository CoRR abs/cs/0611093, 2006.

GRADUATE LEVEL STUDENT SUPERVISION

- Have advised over forty M.Tech. students.
- Graduated Ph.D. students and their thesis titles.

- Amey Karkare (with Prof. Amitabha Sanyal). *Heap Reference Analysis*, 2009.
  (Currently Associate Professor, Dept. of Computer Science and Engineering, IIT Kanpur)
- Bageshri Sathe. *Complexity and Efficiency Issues in Data Flow Analysis*, 2008.
  (Currently at Nvidia, USA)
- Aditya Kanande (with Prof. Amitabha Sanyal). *SPOTS: A system for proving optimizing transformations sound*, 2007.
  (Currently Associate Professor, Dept. of Computer Science and Automation, IISc Bangalore)

- Current Ph.D. students and their proposed topics.
  - Swati Rathi. *Precise data flow analysis in presence of function pointers*.
  - Pritam Gharat. *A functional approach for interprocedural pointer analysis*.
  - Vini Kanwar. *Alias analysis of heap data*.
  - Barnali Basak (with Prof. Supratim Biswas). *Transformation guided polyhedral approach for automatic parallelization*.
  - Shrawan Kumar (with Prof. Amitabha Sanyal). *Precise and scalable property checking*.
  - Anshuman Dhuliya. *Automatic construction of program analysers*.
  - Komal Pathade. *Scalable and precise program analysis*.

PROJECTS AND CONSULTANCY ASSIGNMENTS

Have been a consultant to many companies. The work usually involves training and grooming compiler groups, advising on design issues for compiler related projects etc.

- **Trainings**
  - *GCC Internals for Parallelization and Vectorization*. (With Prof. Supratim Biswas). HP Bangalore. (July 2015).
  - *Program Analysis*. TCS (TRDDC) Pune. (August 2011 to Jan 2012).
  - *Advanced Data Flow Analysis*. NVIDIA, Pune. (December 2011).
  - *Workshop on Compiler Construction with Introduction to GCC*. IIT Bombay, Mumbai. (Dec 2009).
  - *Compiler Back Ends*. (With Prof. Amitabha Sanyal). TCS, Hyderabad. (Sept. 2009).
  - *Compiler Construction: From Practice to Theory*. A workshop under Faculty Development Program of TCS at Pune. (Feb 2009).
  - *Compiler Construction: From Practice to Theory*. IITDM, Jabalpur. (Dec 2008).
  - *Compiler Construction: From Practice to Theory*. A TEQIP (Technical Quality Improvement Program) workshop at College of Engineering, Pune. (Sept 2007).
  - *Automatic Construction of Scannners and Parsers*. Blue Star Infotech Ltd. (Mumbai). (Feb 2007)
  - *Getting Started with Porting GCC*. (With Prof. Amitabha Sanyal and Prof. Supratim Biswas). Infineon (Bangalore). (Feb 2004)
  - *Compiler Construction*. (with Prof. Amitabha Sanyal and Prof. Supratim Biswas). ANURAG, a DRDO lab (Hyderabad). (December 2003)

- *Compiler Back Ends*. (With Prof. Amitabha Sanyal). Synopsys India (Pvt.) Ltd. (December 2002).
- *Ada Programming Language*. (With Prof. H. V. Sahasrabuddhe). Jopasana Software & Systems Pvt. Ltd. (May 2001)
- *Data Flow Analysis*. Tata Infotech Ltd. (December 1999).
- *Language Processing*. Tata Infotech Ltd. (December 1998).
- *Low Level Language Processing Tools*. Cirrus Logic Software (I) Pvt. Ltd. (November 1998).
- *Language Design and Compiler Construction*. Mastek, Pune. (Dec 1996 to May 1997).
- *Bidirectional Data Flow Analysis*. TRDDC, Pune (May 1996 to July 1996).

• Sponsored Projects

- *Scalable and Precise Program Analysis*. Tata Consultancy Services. (Sep 2013 to Aug 2016).
- *Parallel Computing Research Prospects*. (With Prof. S. Biswas). Sponsored by Intel (Jan 2012 to June 2013).
- *GCC Resource Center*. (With Prof. Amitabha Sanyal and Prof. S. Biswas). Sponsored by the Department of Electronics and Information Technology, Ministry of Communication and Information Technology, Government of India. (June 2009 to March 2013).
- *Trusted Translation Systems*. (With Prof. Amitabha Sanyal and Prof. S. Biswas). Centre for Formal Design and Verification of Software. (December 2003 to Dec 2008).
- *Improving GCC port for ANUPAMA and ABACUS processors*. (With Prof. Amitabha Sanyal and Prof. S. Biswas). Sponsored by ANURAG, DRDO. (December 2004 to March 2006).
- *Heap reference analysis for improved garbage collection.* Sponsored by Synopsys India (Pvt.) Ltd. (May 2003 to June 2004).
- *Retargeting of GNU C/C++ compiler and associated tools for ARC100 and ARC200 RISC cores.* Sponsored by ARCUS Technologies Pvt. Ltd., Bangalore (May 1994 to November 1994).

• Consultancy Projects

- *Automatic Vectorization*. Imagination Technologies, Pune. (Sep 2015 to Jan 2016).
- *PL/I to C++ Translation.* (With Prof. Amitabha Sanyal). Patni Computer Systems, Pune (March 2009 to April 2009).
- *Efficient programming with GCC for Tricore.* (With Prof. Amitabha Sanyal and Prof. S. Biswas). Sponsored by Infineon Technologies Ltd., Bangalore (July 2005 to January 2006).
- Tuning of *lcc* for better code generation for UMS chip of Cradle Technologies Ltd. (December 2000 to May 2001).
- Was the chief designer of VxC designed by Tata Infotech Ltd. This is a variant of C for embedded systems applications of Intel (September 2000 Jan 2002).
- Was the principal architect of an optimizing compiler for VxC designed and implemented by Tata Infotech Ltd. for Intels's IXS 1000 Media Signal Processor (September 2000 Jan 2002).

  Some features of this instruction set architecture are : Asymmetric vector and scalar units, generalisation of MAC operation concept, predicated instructions, restricted VLIW architecture with short as well as long instructions, manipulation of data during memory reads and writes, parallel loads and stores, local customisation of execution semantics etc.

- Have carried out the feasibility study for design and implementation of an optimizing compiler for Intel's DSP chip on behalf of Tata Infotech Ltd. (June 2000)
- Have carried out a feasibility study on rapid software development for DSP chips for Cirrus Logic Software (I) Pvt. Ltd. (May 1998 to June 1998).

Talks and Tutorials

- Have conducted tutorials at PLDI 2014 (Edinburgh, UK), PPoPP 2012 (New Orleans, USA), CGO 2011 (Chamonix, France), PPoPP 2010 (Bangalore, India), ETAPS 2008 (Budapest, Hungary), SEFM 2006 (Pune, India).
- Have also delivered research and invited talks at many companies, institutions and conferences.
  - The institutions and organization where I have delivered research talks include CWI (Amsterdam), Dagstuhl Seminars, ETH Zurich, IISc Bangalore, IIT Delhi, IIT Kanpur, IIT Kharagpur, IIT Madras, Imperial College London, INRIA, Max Planck Institute for Software Systems, Oxford University, Princeton University, Rutgers University, Technical University of Vienna, University of California at Berkeley, University of Cambridge, University of Edinburgh, University of Texas at Dallas etc.
  - The companies where I have delivered research talks include ARM (Cambridge UK), HP (Bangalore), IBM (Delhi, Bangalore), KPIT Cummins Infosystems (Pune), Nvidia (Pune), Motorola (Bangalore), Oracle (hyderabad), Persistent Systems (Pune), Symantec (Pune), Synopsys (Bangalore), Tata Infotech (Mumbai), TCS (Pune, Hyderabad) etc.
- Have given numerous motivational, popular, technical talks at over 50 colleges and institutions in India. These talks try to explain what research is in general, what are its implications and requirements etc.
- A partial list of talks that I have delivered is as follows:
  - What is research.
  - How to write a good research paper.
  - So you want to do Ph.D.?
  - How to make good presentations.
  - Demystifying GCC: Or what the GCC manuals should tell you, but they don't.
  - Essential abstractions in GCC.
  - Demystifying GCC through graybox probing.
  - specRTL: A language for GCC machine descriptions.
  - Early history of FORTRAN: The making of a wonder.
  - Bidirectional data flow analysis: Myths and reality.
  - Liveness analysis of heap.
    (A compucast podcast of an interview on this talk can be found at `http://www.computersciencepodcast.com/podcasts.html` while a YouTube promotional video can be found at `http://www.youtube.com/watch?v=BuFowbhPsVY`).
  - Static analysis of programs: A heap centric view.

- Liveness based pointer analysis.
- The mathematics, science, and engineering of pointer analysis.
- The abstraction and approximation dilemma in pointer analysis.
- Simplicity, generality, and efficiency of interprocedural data flow analysis: Resurrecting the classical call strings method.

Other Professional Activities

- Co-organiser of workshop on *New Horizons in Compilers* in conjuction with International Conference on High Performance Computing (HiPC).
- Program committee International Conference on High Performance Computing (HiPC).
- Reviewer for ACM TOPLAS, POPL, PLDI, SAS, Software Practice and Experience, CC, CGO, etc.
- Member, Senate of IIITDM, Jabalpur.
- Member of Board of Studies in Computer Science at University of Mumbai, College of Engineering Pune, College of Engineering Aurangabad, Amravati University, Rani Durgawati Vishwavidyalaya, Jabalpur etc.
- Member of selection committees for faculty selection in various colleges.
- Administrative responsibilities at both the department and institute level at IIT Bombay.