

# Eric Grosse

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## Employment

### Google

*VP - Security & Privacy Engineering*  
*Engineering Director*

Aug 2011—Mar 2017

Apr 2007—Aug 2011

Google Security Team of approximately seven hundred engineers, responsible for protecting the security of users, customers, staff, and systems.

### Bell Laboratories, Murray Hill NJ

*CTO, CloudControl*

Sep 2005—Apr 2007

*Bell Labs Fellow*

May 2005

*Director, Secure Networking Research*

May 1997—Sep 2005

*Department Head, Scientific Computing Research*

May 1996—Apr 1997

*Distinguished Member of Technical Staff*

September 1993—present

*Member of Technical Staff*

summer 1978, November 1980—August 1993

Wide variety of topics in scientific computing and secure networking; see next page.

### Stanford Linear Accelerator Center, Palo Alto CA

*Numerical Analysis Consultant*

summer 1977

Numerical Analysis Program Library.

### General Motors Research Labs, Warren MI

*Research Mathematician*

summer 1976

Algorithms for paint spray robot and sheet metal bending.

### Argonne National Labs, Argonne IL

*Summer Research Participant*

summer 1975

Helped test Linpack as it was being completed.

### Structural Dynamics Research Corp., Cincinnati OH

*part-time, after school*

January—August 1971

Ported a collection of engineering codes.

## Education

### Stanford University

1975—1980

My Computer Science Ph.D. under Gene Golub presented a method for fitting spectral data from protein crystallography using tensor product splines and then used a specialized optimization technique on that representation to efficiently and accurately locate the thousands of local maxima of biochemical interest. Also, I proved a surprising result on the stability of the normal equations for least squares tensor splines. NSF Graduate Fellowship, research and teaching assistantships.

### Michigan State University

1971—1975

B.S. Mathematics, Alumni Distinguished Scholar, National Merit Scholar, Honors College, Phi Beta Kappa, Pi Mu Epsilon.

## Other

Have served on the editorial boards of: ACM Trans. Math. Software, IEEE Computational Science & Engineering, Netlib/NHSE, Numerical Algorithms, SIAM Journal on Scientific Computing, SIAM News, SIAM Software Environments and Tools. Co-chair, SIAM Electronic Publishing. SIAM Board of Trustees and Council. U.S. citizen. Active clearance.

## Research Program

**Information security** has been my main interest for the past couple decades. At Google I worked with a group I consider among the best in the world at fighting off actual and potential threats to our users' data. Some of the team's work is published in conferences or open source; some is kept confidential as needed by security operations. We refused to accept the status quo of crime and espionage and helped move industry best practices from a "fire code" model of checklists to a "red team" model of testing against adversaries, focusing on defense, detection, and response: FIDO U2F Security Key authentication, whitelisting of active content, driven by malware reverse engineering, pervasive crypto (SSL with Certificate Transparency; e2email and Upspin), robust apps by design, looking through logs for bad actors.

Previously at Bell Labs I was creator and technical lead on Alcatel-Lucent's (cancelled) security product, CloudControl, which throttled trash traffic by analyzing at the enterprise but enforcing in the service provider cloud. Before that, I was part of the redesign of the Plan 9 operating system security model, using encrypted key exchange to bootstrap an agent-based authentication mechanism, which won a Best Paper award at USENIX Security 2002. I held responsibility for the Bell Labs security strategy for VoIP and IMS. Earlier, I supervised the group creating Lucent's firewall product and contributed the security part of a novel VPN system, Viaduct, still the most popular telecommuting access for Bell Labs researchers. More broadly, I am working toward a world whose network infrastructure will be more secure and self-diagnosing.

**Network services** may seem recent, but in the early eighties our "netlib" collection of mathematical software quickly became a dominant source of numerical algorithms for the computing world, and the systems and security issues involved in scaling that up were intriguing. The experience also contributed to SIAM's move to electronic journal publication and to corporate web services, for example an intensive weekend in which we built AT&T's 800 number directory. At the same time, heavy numerical calculations were moved onto the network at Bell Labs for domain decomposition methods for differential equation solution and for web-based optimization through AMPL.

**Algorithms for approximation and visualization**, especially ones driven by problems from semiconductor design and fabrication, were the main theme of my first years at Bell Labs.

Powerful tools like splines enabled rapid addition of new transistor designs into circuit simulators that had previously used ad hoc, labor intensive semi-analytic models. Technically, this was a challenge because of the multiple variables, the need to preserve monotonicity, and the continuity and performance requirements. In combination with numerical optimization, some of these spline techniques allow unique nondestructive measurement of heterostructure lasers.

For 2D and 3D semiconductor device partial differential equations, interpretation of the voluminous output is almost as challenging and computationally expensive as the simulations themselves. RenderMan animations of field variables and aural rendering of scalar variables helped us understand and convey issues with CMOS latchup and other phenomena of engineering importance.

My other multivariate approximation innovations include: isosurface-aligned grids, critical to more accurate silicon energy band models for Boltzman transport; multivariate generalization of the lowess moving least squares algorithm, widely used in the statistical community for smoothing scattered data; first proof of non-obtuse, no-small-angle triangulation of polygons, a result that launched a flurry of additional work on the outside leading to some of today's best grid generators.

Throughout my career, I've been known locally and in the world community as someone on the lookout for creative approaches to real-life problems, implemented in solid, reusable software, and comfortable leading teams of able, independent-minded researchers to make good things happen.

## Refereed journal and conference papers

1. Tony F. Chan, William M. Coughran, Jr., Eric H. Grosse, and Michael T. Heath. A numerical library and its support. *ACM Trans. Math. Software*, 6(2):135–145, June 1980.
2. E. H. Grosse. Tensor spline approximation. *Linear Algebra and Its Applications*, 34:29–41, 1980.
3. Petter E. Bjørstad, Germund Dahlquist, and Eric H. Grosse. Extrapolation of asymptotic expansions by a modified Aitken  $\delta^2$ -formula. *BIT*, 21(1):56–65, 1981.
4. W. M. Coughran, Jr., E. H. Grosse, and D. J. Rose. CAzM: A circuit-analyzer with macromodeling. *IEEE Trans. on Electron Devices*, ED-30:1207–1213, 1983.
5. J. H. Friedman, E. H. Grosse, and W. Stuetzle. Multidimensional additive spline approximation. *SIAM J. Sci. Stat. Comput.*, 4:291–301, 1983.
6. Wesley Petersen, Wolfgang Fichtner, and Eric Grosse. Vectorized Monte Carlo calculation for the transport of ions in amorphous targets. *IEEE Trans. on Electron Devices*, ED-30:1011–1017, 1983.
7. Brenda S. Baker, S. J. Fortune, and Eric H. Grosse. Stable prehension with a multi-fingered hand. Pages 114–120 in *Proceedings of the Seventeenth Annual ACM Symposium on Theory of Computing, Providence, Rhode Island, May 6–8, 1985*, New York, NY 10036, USA, 1985. ACM Press.
8. R. E. Bank, W. M. Coughran, Jr., W. Fichtner, E. H. Grosse, D. J. Rose, and R. K. Smith. Transient simulation of silicon devices and circuits. *IEEE Trans. on Computer-Aided Design*, CAD-4:436–451, 1985. (also *IEEE Trans. on Electron Devices* ED-32).
9. William M. Coughran, Jr., Eric Grosse, and Donald J. Rose. Variation diminishing splines in simulation. *SIAM J. Sci. Stat. Comput.*, 7:696–705, 1986.
10. Eric Grosse. Spectral spline approximation. In C. K. Chui, L. L. Schumaker, and J. D. Ward, editors, *Approximation Theory V*, pages 363–366 (of xviii + 654), New York, NY, USA, 1986. Academic Press.
11. P. E. Bjørstad and E. H. Grosse. Conformal mapping of circular arc polygons. *SIAM J. Sci. Stat. Comput.*, 8:19–32, 1987.
12. Bruno Bosacchi, Robert C. Oehrle, and Eric Grosse. Nondestructive characterization of multilayer structures by resonant attenuated total reflection spectroscopy. *Applied Physics Letters*, 51:158–160, 1987.
13. W. M. Coughran, Jr., Eric Grosse, and Donald J. Rose. Aspects of computational circuit analysis. In W. Fichtner and M. Morf, editors, *VLSI CAD Tools and Applications*, pages 105–127 (of x + 552), Dordrecht, The Netherlands, 1987. Kluwer Academic Press.
14. Jack J. Dongarra and Eric Grosse. Distribution of mathematical software via electronic mail. *Communications of the ACM*, 30:403–407, 1987.
15. Brenda Baker, Eric Grosse, and Conor Rafferty. Non-obtuse triangulation of polygons. *J. Discrete and Computational Geometry*, 3:147–168, 1988.
16. William S. Cleveland, Susan J. Devlin, and Eric Grosse. Regression by local fitting: Methods, properties, and computational algorithms. *J. Econometrics*, 37:87–114, 1988.
17. W. M. Coughran, Jr., W. Fichtner, and Eric Grosse. Extracting transistor charges from device simulations by gradient fitting. *IEEE Trans. on Computer-Aided Design*, 8:380–394, 1989.

18. Eric Grosse. LOESS: Multivariate smoothing by moving least squares. In C. K. Chui, L. L. Schumaker, and J. D. Ward, editors, *Approximation Theory VI*, pages 299–302, New York, NY, USA, 1989. Academic Press.
19. W. M. Coughran, Jr. and Eric Grosse. Techniques for scientific animation. *SPIE Proceedings*, 1259:72–79, 1990.
20. W. M. Coughran, Jr. and Eric Grosse. Techniques for scientific animation—video. *SPIE Proceedings*, 1259-V:22:00–35:28, 1990.
21. Eric Grosse. A catalogue of algorithms for approximation. In J. Mason and M. Cox, editors, *Algorithms for Approximation II*, pages 479–514 (of 514), London, England, 1990. Chapman and Hall.
22. William S. Cleveland and Eric Grosse. Computational methods for local regression. *Statistics and Computing*, 1(1):47–62, 1991.
23. W. M. Coughran, Jr. and Eric Grosse. Seeing and hearing dynamic loess surfaces. In *Interface'91 Proceedings*, pages 224–228, Berlin, Heidelberg, New York, Tokyo, 1991. Springer-Verlag.
24. Eric Grosse. How shall we connect our software tools. In *Visualization'91 Proceedings*, pages 292–296 (of xi + 437), 1109 Spring Street, Suite 300, Silver Spring, MD 20910, USA, 1991. IEEE.
25. W. M. Coughran, Jr., E. H. Grosse, and M. R. Pinto. Computing folds and bifurcations in current-voltage characteristics of semiconductor devices. In *Workshop on Numerical Modeling of Processes and Devices for Integrated Circuits: NUPAD IV. Technical Digest*, pages 149–153, 1109 Spring Street, Suite 300, Silver Spring, MD 20910, USA, 1992. IEEE.
26. Eric Grosse. Approximation in VLSI simulation. *Numerical Algorithms*, 5:591–601, 1993.
27. Eric Grosse and John D. Hobby. Improved rounding for spline coefficients and knots. *Math. Comp.*, 63(207):175–194, 1994.
28. Brenda S. Baker and Eric Grosse. Local control over filtered WWW access. In *Fourth International World Wide Web Conference*, 103a Morris Street, Sebastopol, CA 95472, USA, December 1995. O'Reilly & Associates, Inc. Boston, MA.
29. Petter Bjørstad, W. M. Coughran, Jr., and Eric Grosse. Parallel domain decomposition applied to coupled transport equations. In David E. Keys and Jinchao Xu, editors, *Domain Decomposition Methods in Scientific and Engineering Computing*, pages 369–380, Providence, RI, USA, 1995. American Mathematical Society.
30. Shirley Browne, Jack Dongarra, Stan Green, Keith Moore, Theresa Pepin, Tom Rowan, Reed Wade, and Eric Grosse. Location-independent naming for virtual distributed software repositories. In *Symposium on Software Reusability*, New York, NY 10036, USA, April 1995. ACM Press. Seattle, Washington.
31. Ronald Boisvert, Shirley Browne, and Jack Dongarra. Digital software and data repositories for support of scientific computing. In *Digital Libraries Forum*, Berlin, Heidelberg, New York, Tokyo, May 1995. Springer-Verlag. McLean, Virginia.
32. Eric Grosse. Repository mirroring. *ACM Trans. Math. Software*, 21(1):89–97, March 1995.
33. David M. Gay and Eric Grosse. Self-adapting Fortran 77 machine constants: Comment on Algorithm 528. *ACM Trans. Math. Software*, 25(1):123–126, March 1999.

34. Cliff Young, Y. N. Lakshman, Tom Szymanski, John Reppy, David Presotto, Rob Pike, Girija Narlikar, Sape Mullender, and Eric Grosse. Protium, and infrastructure for partitioned applications. In *Eighth IEEE Workshop on Hot Topics in Operating Systems (HotOS-VIII)*. May 20–23, 2001, Schloss Elmau, Germany, pages 41–46, 1109 Spring Street, Suite 300, Silver Spring, MD 20910, USA, 2001. IEEE. IEEE catalog number PR01040.
35. Russ Cox, Eric Grosse, Rob Pike, David Presotto, and Sean Quinlan. Security in Plan 9. In *Proceedings of the 11th USENIX Security Symposium, August 5–9, 2002, San Francisco, CA, USA.*, pages 3–16. ISBN 1-931971-00-5, USENIX Association, 2560 Ninth St., Suite 215, Berkeley CA 94710 USA.
36. Eric Grosse and Y. N. Lakshman. Network processors applied to IPv4/IPv6 transition. *IEEE Networks* 17(4):35–39, July 2003.
37. Erik Anderlind et al. IMS Security. *Bell Labs Technical Journal* 11(1):37-58, 2006.
38. Jack Dongarra and Gene H. Golub and Eric Grosse and Cleve Moler and Keith Moore, Netlib and NA-Net: Building a Scientific Computing Community. *IEEE Annals of the History of Computing* 30(2):30–41, 2008.
39. Eric Grosse and Mayank Upadhyay, Authentication at Scale. *IEEE Security and Privacy* 11(1):15–22, 2013.

## Technical reports and unrefereed publications

1. C. Johnson and E. H. Grosse. Interpolation polynomials, minimal spanning trees and ridge-line analysis in density map interpretation. *American Crystallographic Association Program and Abstracts*, 4(2):48, 1976.
2. T. F. Chan, W. M. Coughran, Jr., E. H. Grosse, M. T. Heath, and F. T. Luk. Numerical analysis program library user’s guide (NAPLUG). User Note 82, SLAC Computing Services, 1976.
3. E. H. Grosse. Software restyling in graphics and programming languages. Pages 79–108 in *Proceedings of the 1978 Army Numerical Analysis and Computers Conference (15th: 1978: U.S. Army Missile Research and Development Command, Redstone Arsenal, Alabama)*, number 78-3 in ARO report. U.S. Army Research Office, 1978.
4. E. H. Grosse and M. H. Wright. Numerical analysis for model building and refinement. In *National Resource for Computation Chemistry workshop*, 1978.
5. W. M. Coughran, Jr. and E. H. Grosse. New languages for numerical software. *SIGNUM Newsletter*, 14:73–75, 1979.
6. E. H. Grosse. *Approximation and Optimization of Electron Density Maps*. PhD thesis, Stanford University Computer Science Department, 1981. STAN-CS-80-835.
7. W. M. Coughran, Jr. and E. H. Grosse. The grove editor. Numerical Analysis Manuscript 83-3, ATT Bell Laboratories, 1983.
8. E. H. Grosse and W. M. Coughran, Jr. The pine programming language. Numerical Analysis Manuscript 83-4, ATT Bell Laboratories, 1983.
9. Wesley Petersen, Wolfgang Fichtner, and Eric Grosse. Distribution functions for ion ranges. Numerical analysis manuscript, ATT Bell Laboratories, 1983.
10. Eric Grosse. Colors for level plots. Numerical Analysis Manuscript 85-1, ATT Bell Laboratories, 1985.

11. Greg Astfalk, Jack Dongarra, and Eric Grosse. Finding public domain mathematical software. Numerical Analysis Manuscript 87-5, AT&T Bell Laboratories, Murray Hill, NJ, USA, 1987.
12. Eric Grosse and Cleve Moler. Underflow can be harmful. *SIAM News*, 20(6):1, 1987.
13. W. M. Coughran, Jr. and Eric Grosse. A philosophy for scientific computing tools. *SIGNUM Newsletter*, 24(2/3):2–9, 1989.
14. Jack Dongarra and Eric Grosse. Shopping for mathematical software electronically. *IEEE Potentials*, 8:37–38, February 1989. condensed version of CACM paper.
15. Eric Grosse. Netlib news. *SIGNUM Newsletter*, 1990. Oct 90, Jan 91, Apr 92.
16. William S. Cleveland, Eric Grosse, and William M. Shyu. Local regression models. In John M. Chambers and Trevor J. Hastie, editors, *Statistical Models in S*, pages 309–376 (of xv + 608), Belmont, CA, USA and Pacific Grove, CA, USA, 1991. Wadsworth and Brooks/Cole.
17. W. M. Coughran, Jr. and Eric Grosse. Display of functions of three space variables and time using shaded polygons and sound. Pages 271–276 in P. W. Gaffney and E. N. Houstis, editors. *Programming environments for high-level scientific problem solving: Proceedings of the IFIP TC2/WG 2.5 Working Conference on Programming Environments for High-Level Scientific Problem Solving, Karlsruhe, Amsterdam, The Netherlands, 1992*. North-Holland.
18. Joan Feigenbaum, Eric Grosse, and James A. Reeds. Cryptographic protection of membership lists. *Newsletter of the International Association for Cryptologic Research*, 9(1):16–20, 1992.
19. Shirley Browne, Jack Dongarra, Eric Grosse, and Tom Rowan. The Netlib Mathematical Software Repository. *D-Lib magazine: the magazine of the Digital Library Forum*, September 1995.
20. Eric Grosse. Network programming and CSE. *IEEE Computational Science & Engineering*, 3(2):40–41, Summer 1996.
21. Eric Grosse. Real Inferno. Pages 270–279 in Ronald F. Boisvert, editor, *The Quality of Numerical Software: Assessment and Enhancement: Proceedings of the IFIP TC2/WG 2.5 Working Conference on the Quality of Numerical Software, Oxford, United Kingdom, 8–12 July 1996*, London, 1997. Chapman Hall on behalf of IFIP.
22. Eric Grosse and Y. N. Lakshman. Getting Ready for Larger IPv6 Clouds. Bell Laboratories Computing Sciences Technical Report, 2002.
23. Peter Bosch, Eric Grosse, Y. N. Lakshman, Girija Narlikar, John Reppy, and Cliff Young. Universal Data Service through Application Partitioning. Bell Laboratories Computing Sciences Technical Report, 2002.

## Patents

1. Brenda Baker and Eric Grosse. System and method for database access control. patent 5,696,898, U.S.Patent and Trademark Office, Dec 1997.
2. Brenda Baker and Eric Grosse. System and method for restricting user access rights on the internet based on rating information stored in a relational database. patent 5,678,041, U.S.Patent and Trademark Office, Oct 1997.
3. Eric Grosse and David Presotto. Database dependency resolution method and system for identifying related data files. patent 5,734,886, U.S.Patent and Trademark Office, Mar 1998.
4. Eric Grosse. Computer security using virus probing. patent 6,205,551, U.S.Patent and Trademark Office, Mar 2001.
5. Victor Boyko, Eric Grosse, Philip MacKenzie, and Sarvar Patel. Secure Mutual Network Authentication And Key Exchange Protocol. patent 7,047,408, U.S.Patent and Trademark Office, May 2006.
6. Andrew Clark, Eric Grosse, and Mark Kraml. Capacity allocation in a wireless communication system patent 7,477,902, U.S.Patent and Trademark Office, Jan 2009.