



Michael Saunders

Professor (Research) of Management Science and Engineering, Emeritus

 Curriculum Vitae available Online

Bio

BIO

Saunders develops mathematical methods for solving large-scale constrained optimization problems and large systems of equations. He also implements such methods as general-purpose software to allow their use in many areas of engineering, science, and business. He is co-developer of the large-scale optimizers MINOS, SNOPT, SQOPT, PDCO, the dense QP and NLP solvers LSSOL, QPOPT, NPSOL, and the linear equation solvers SYMMLQ, MINRES, MINRES-QLP, LSQR, LSMR, LSLQ, LNLQ, LSRN, LUSOL.

ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Management Science and Engineering
- Member, Institute for Computational and Mathematical Engineering (ICME)

HONORS AND AWARDS

- Orchard-Hays Prize, MPS (1985)
- Highly Cited Researcher, Computer Science, ISI (2004)
- Highly Cited Researcher, Mathematics, ISI (2007)
- Honorary Fellow, RSNZ (2007)
- Linear Algebra Prize, SIAM (2012)
- Invention Hall of Fame, OTL, Stanford University (2012)
- Fellow, SIAM (2013)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, ACM (1982 - present)
- Associate Editor, NACO (2010 - 2016)
- Member, INFORMS (2010 - present)
- Member, ORSNZ (1990 - present)
- Member, SIAM (1980 - present)
- Associate Editor, ACM TOMS (1982 - 2004)
- Associate Editor, SIAM Journal on Optimization (1989 - 2002)
- Associate Editor, OPTE (1999 - present)

PROFESSIONAL EDUCATION

- B.Sc. (Hons), Canterbury , Mathematics (1965)
- MS, Stanford University , Computer Science (1970)
- PhD, Stanford University , Computer Science (1972)

LINKS

- My homepage: <http://stanford.edu/~saunders/>
- My lab site: <http://stanford.edu/group/SOL>
- Where my office and students are (most of them): <http://icme.stanford.edu/>
- Homepage for our DOE and NIH grants: <http://stanford.edu/group/SOL/multiscale/>

Publications

PUBLICATIONS

- **IMPLEMENTING A SMOOTH EXACT PENALTY FUNCTION FOR EQUALITY-CONSTRAINED NONLINEAR OPTIMIZATION** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
Estrin, R., Friedlander, M. P., Orban, D., Saunders, M. A.
2020; 42 (3): A1809–A1835
- **IMPLEMENTING A SMOOTH EXACT PENALTY FUNCTION FOR GENERAL CONSTRAINED NONLINEAR OPTIMIZATION** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
Estrin, R., Friedlander, M. P., Orban, D., Saunders, M. A.
2020; 42 (3): A1836–A1859
- **Analysis of the Regularization Parameters of Primal-Dual Interior Method for Convex Objectives Applied to H-1 Low Field Nuclear Magnetic Resonance Data Processing (vol 49, pg 1129, 2018)** *APPLIED MAGNETIC RESONANCE*
Campisi-Pinto, S., Levi, O., Benson, D., Cohen, M., Resende, M., Saunders, M., Linder, C., Wiesman, Z.
2019; 50 (1-3): 521
- **EUCLIDEAN-NORM ERROR BOUNDS FOR SYMMLQ AND CG** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
Estrin, R., Orban, D., Saunders, M.
2019; 40 (1): 235–53
- **LSLQ: AN ITERATIVE METHOD FOR LINEAR LEAST-SQUARES WITH AN ERROR MINIMIZATION PROPERTY** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
Estrin, R., Orban, D., Saunders, M. A.
2019; 40 (1): 254–75
- **Stabilized Optimization Via an NCL Algorithm**
Ma, D., Judd, K. L., Orban, D., Saunders, M. A., AlBaali, M., Grandinetti, L., Purnama, A.
SPRINGER.2018: 173–91
- **Reliable and efficient solution of genome-scale models of Metabolism and macromolecular Expression** *SCIENTIFIC REPORTS*
Ma, D., Yang, L., Fleming, R. M., Thiele, I., Palsson, B. O., Saunders, M. A.
2017; 7
- **Conditions for duality between fluxes and concentrations in biochemical networks** *JOURNAL OF THEORETICAL BIOLOGY*
Fleming, R. M., Vlassis, N., Thiele, I., Saunders, M. A.
2016; 409: 1-10
- **Laplace inversion of low-resolution NMR relaxometry data using sparse representation methods** *Concepts in Magnetic Resonance Part A*
Berman, P., Levi, O., Parmet, Y., Saunders, M., Wiesman, Z.
2013; 42A:3: 72-88
- **Novel 1H low field nuclear magnetic resonance applications for the field of biodiesel** *Biotechnologyfor Biofuels*

-
- Berman, P., Leshem, A., Etziony, O., Levi, O., Parmet, Y., Saunders, M., Wiesman, Z.
2013; 6:55: 20
- **LSRN: a parallel iterative solver for strongly over- or under-determined systems** *SIAM J. Sci. Comp.*
Meng, X., Saunders, M. A., Mahoney, M. W.
2013; 36 (2): C95-C118
 - **A variational principle for computing nonequilibrium fluxes and potentials in genome-scale biochemical networks** *JOURNAL OF THEORETICAL BIOLOGY*
Fleming, R. M., MAES, C. M., Saunders, M. A., Ye, Y., Palsson, B. O.
2012; 292: 71-77
 - **LSMR: AN ITERATIVE ALGORITHM FOR SPARSE LEAST-SQUARES PROBLEMS** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
Fong, D. C., Saunders, M.
2011; 33 (5): 2950-2971
 - **SNOPT: An SQP algorithm for large-scale constrained optimization, SIGEST article** *SIAM Rev.*
Gill, P., E., Murray, W., Saunders, M., A.
2005; 1 (47): 99-131
 - **Atomic decomposition by basis pursuit, SIGEST article** *SIAM Rev.*
Chen, S., S., Donoho, D., L., Saunders, M., A.
2001; 1 (43): 129-159
 - **Properties of semi-conjugate gradient methods for solving unsymmetric positive definite linear systems** *OPTIMIZATION METHODS & SOFTWARE*
Huang, N., Dai, Y., Orban, D., Saunders, M. A.
2023
 - **HyKKT: a hybrid direct-iterative method for solving KKT linear systems** *OPTIMIZATION METHODS & SOFTWARE*
Regev, S., Chiang, N., Darve, E., Petra, C. G., Saunders, M. A., Swirydowicz, K., Peles, S.
2022
 - **Linear solvers for power grid optimization problems: A review of GPU-accelerated linear solvers** *PARALLEL COMPUTING*
Swirydowicz, K., Darve, E., Jones, W., Maack, J., Regev, S., Saunders, M. A., Thomas, S. J., Peles, S.
2022; 111
 - **LARGE-SCALE OPTIMIZATION WITH LINEAR EQUALITY CONSTRAINTS USING REDUCED COMPACT REPRESENTATION** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
Brust, J. J., Marcia, R. F., Petra, C. G., Saunders, M. A.
2022; 44 (1): A103-A127
 - **Linear systems arising in interior methods for convex optimization: a symmetric formulation with bounded condition number** *OPTIMIZATION METHODS & SOFTWARE*
Ghannad, A., Orban, D., Saunders, M. A.
2021
 - **Simulation-Based Sensitivity Analysis of Regularization Parameters for Robust Reconstruction of Complex Material's T-1 - (T2H)-H-1 LF-NMR Energy Relaxation Signals** *APPLIED MAGNETIC RESONANCE*
Campisi-Pinto, S., Levi, O., Benson, D., Resende, M., Saunders, M., Linder, C., Wiesman, Z.
2019
 - **Creation and analysis of biochemical constraint-based models using the COBRA Toolbox v.3.0.** *Nature protocols*
Heirendt, L., Arreckx, S., Pfau, T., Mendoza, S. N., Richelle, A., Heinken, A., Haraldsdottir, H. S., Wachowiak, J., Keating, S. M., Vlasov, V., Magnusdottir, S., Ng, C. Y., Preciat, et al
2019
 - **DynamicME: dynamic simulation and refinement of integrated models of metabolism and protein expression.** *BMC systems biology*
Yang, L., Ebrahim, A., Lloyd, C. J., Saunders, M. A., Palsson, B. O.
2019; 13 (1): 2

- **LNQ: AN ITERATIVE METHOD FOR LEAST-NORM PROBLEMS WITH AN ERROR MINIMIZATION PROPERTY** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
Estrin, R., Orban, D., Saunders, M. A.
2019; 40 (3): 1102–24
- **Estimating Cellular Goals from High-Dimensional Biological Data**
Yang, L., Saunders, M. A., Lachance, J., Palsson, B. O., Bento, J., Assoc Comp Machinery
ASSOC COMPUTING MACHINERY.2019: 2202–11
- **Analysis of the Regularization Parameters of Primal-Dual Interior Method for Convex Objectives Applied to H-1 Low Field Nuclear Magnetic Resonance Data Processing** *APPLIED MAGNETIC RESONANCE*
Campisi-Pinto, S., Levi, O., Benson, D., Cohen, M., Resende, M., Saunders, M., Linder, C., Wiesman, Z.
2018; 49 (10): 1129–50
- **Principles of proteome allocation are revealed using proteomic data and genome-scale models** *SCIENTIFIC REPORTS*
Yang, L., Yurkovich, J. T., Lloyd, C. J., Ebrahim, A., Saunders, M. A., Palsson, B. O.
2016; 6
- **solveME: fast and reliable solution of nonlinear ME models.** *BMC bioinformatics*
Yang, L., Ma, D., Ebrahim, A., Lloyd, C. J., Saunders, M. A., Palsson, B. O.
2016; 17 (1): 391
- **Heart rate analysis by sparse representation for acute pain detection** *MEDICAL & BIOLOGICAL ENGINEERING & COMPUTING*
Tejman-Yarden, S., Levi, O., Beizerov, A., Parmet, Y., Tu Nguyen, T., Saunders, M., Rudich, Z., Perry, J. C., Baker, D. G., Moeller-Bertram, T.
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- **A Practical Factorization of a Schur Complement for PDE-Constrained Distributed Optimal Control** *JOURNAL OF SCIENTIFIC COMPUTING*
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- **Systems biology definition of the core proteome of metabolism and expression is consistent with high-throughput data.** *Proceedings of the National Academy of Sciences of the United States of America*
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- **Study of liquid-phase molecular packing interactions and morphology of fatty acid methyl esters (biodiesel).** *Biotechnology for biofuels*
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- **LSRN: A PARALLEL ITERATIVE SOLVER FOR STRONGLY OVER- OR UNDERDETERMINED SYSTEMS.** *SIAM journal on scientific computing : a publication of the Society for Industrial and Applied Mathematics*
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- **Algorithm 937: MINRES-QLP for Symmetric and Hermitian Linear Equations and Least-Squares Problems** *ACM TRANSACTIONS ON MATHEMATICAL SOFTWARE*
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- **Algorithm 937: MINRES-QLP for Symmetric and Hermitian Linear Equations and Least-Squares Problems.** *ACM transactions on mathematical software. Association for Computing Machinery*
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- **LSRN: A PARALLEL ITERATIVE SOLVER FOR STRONGLY OVER- OR UNDERDETERMINED SYSTEMS** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
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- **PROXIMAL NEWTON-TYPE METHODS FOR MINIMIZING COMPOSITE FUNCTIONS** *SIAM JOURNAL ON OPTIMIZATION*
Lee, J. D., Sun, Y., Saunders, M. A.
2014; 24 (3): 1420-1443
- **Robust flux balance analysis of multiscale biochemical reaction networks** *BMC BIOINFORMATICS*
Sun, Y., Fleming, R. M., Thiele, I., Saunders, M. A.
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- **Equispaced Pareto front construction for constrained bi-objective optimization** *MATHEMATICAL AND COMPUTER MODELLING*
Pereyra, V., Saunders, M., Castillo, J.
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- **Robust flux balance analysis of multiscale biochemical reaction networks** *BMC Bioinformatics*
Fleming, R. M., Saunders, M. A.
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- **CG versus MINRES: An empirical comparison** *SQUJournal for Science*
Fong, D., C.-L., Saunders, M., A.
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Ponnappalli, S. P., Saunders, M. A., Van Loan, C. F., Alter, O.
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- **MINRES-QLP: A KRYLOV SUBSPACE METHOD FOR INDEFINITE OR SINGULAR SYMMETRIC SYSTEMS** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
Choi, S. T., Paige, C. C., Saunders, M. A.
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- **STABILIZING POLICY IMPROVEMENT FOR LARGE-SCALE INFINITE-HORIZON DYNAMIC PROGRAMMING** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
O'Sullivan, M. J., Saunders, M. A.
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- **Discussion: The Dantzig selector: Statistical estimation when p is much larger than n** *ANNALS OF STATISTICS*
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- **Commentary on Methods for modifying matrix factorizations** *Milestones in Matrix Computation: Selected Works of Gene H. Golub With Commentaries*
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- **SpaseLoc: An adaptive subproblem algorithm for scalable wireless sensor network localization** *SIAM JOURNAL ON OPTIMIZATION*
Carter, M. W., Jin, H. H., Saunders, M. A., Ye, Y.
2006; 17 (4): 1102-1128
- **SNOPT: An SQP algorithm for large-scale constrained optimization (Reprinted from SIAM Journal Optimization, vol 12, pg 979-1006, 2002)** *SIAM REVIEW*
Gill, P. E., Murray, W., Saunders, M. A.
2005; 47 (1): 99-131
- **A globally convergent linearly constrained Lagrangian method for nonlinear optimization** *SIAM JOURNAL ON OPTIMIZATION*
Friedlander, M. P., Saunders, M. A.
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- **Sparsity and smoothness via the fused lasso** *JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B-STATISTICAL METHODOLOGY*
Tibshirani, R., Saunders, M., Rosset, S., Zhu, J., Knight, K.
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- **A bisection algorithm for the mixed mu upper bound and its supremum** *American Control Conference*
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- **Subspace preconditioned LSQR for discrete ill-posed problems** *Conference on Computational Linear Algebra with Applications*
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- **SNOPT: An SQP algorithm for large-scale constrained optimization** *SIAM JOURNAL ON OPTIMIZATION*
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- **Global controller optimization using Horowitz bounds**
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- **Atomic decomposition by basis pursuit** *SIAM REVIEW*
Chen, S. S., Donoho, D. L., Saunders, M. A.
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- **Atomic decomposition by basis pursuit** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
Chen, S. S., Donoho, D. L., Saunders, M. A.
1998; 20 (1): 33-61
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Gill, P., E., Murray, W., Saunders, M., A.
1998
- **OSSE mapping of galactic 511 keV positron annihilation line emission** *ASTROPHYSICAL JOURNAL*
Purcell, W. R., Cheng, L. X., Dixon, D. D., Kinzer, R. L., Kurfess, J. D., Leventhal, M., Saunders, M. A., Skibo, J. G., Smith, D. M., Tueller, J.
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Saunders, M. A.
1997; 37 (1): 96-104
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Dixon, D. D., Kolaczyk, E. D., Samimi, J., Saunders, M. A.
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- **Cholesky-based methods for sparse least squares: The benefits of regularization** *AMS/IMS/SIAM Summer Research Conference on Linear and Nonlinear Conjugate Gradient-Related Methods*
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- **On the stability of Cholesky factorization for symmetric quasidefinite systems** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
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- **A PRACTICAL INTERIOR-POINT METHOD FOR CONVEX-PROGRAMMING** *SIAM JOURNAL ON OPTIMIZATION*
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- **THE SIMPLEX ALGORITHM WITH A NEW PRIMAL AND DUAL PIVOT RULE** *OPERATIONS RESEARCH LETTERS*
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- **SOLVING REDUCED KKT SYSTEMS IN BARRIER METHODS FOR LINEAR-PROGRAMMING** *15th Dundee Conference on Numerical Analysis*
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- **Fortran software for optimization** *1995 NSF Design and Manufacturing Grantees Conference*
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- **2 CONJUGATE-GRADIENT-TYPE METHODS FOR UNSYMMETRIC LINEAR-EQUATIONS** *SIAM JOURNAL ON NUMERICAL ANALYSIS*
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