Stanford

Michael Saunders

Professor (Research) of Management Science and Engineering, Emeritus

Curriculum Vitae available Online

CONTACT INFORMATION

- **Administrator**

  Jim Fabry - Administrative Associate

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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/

Teaching

COURSES

2018-19

- Large-Scale Numerical Optimization: CME 338 (Spr)
- Linear Algebra and Optimization Seminar: CME 510 (Aut, Win, Spr)

2017-18

- Large-Scale Numerical Optimization: CME 338, MS&E 318 (Spr)
- Linear Algebra and Optimization Seminar: CME 510 (Aut, Win, Spr)

2016-17

- Large-Scale Numerical Optimization: CME 338, MS&E 318 (Spr)
- Linear Algebra and Optimization Seminar: CME 510 (Aut, Win, Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Junzi Zhang

Doctoral Dissertation Co-Advisor (NonAC)

Shaked Regev

Publications

PUBLICATIONS

- **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-scaleconstrained 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

- **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

- **LNLQ: 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

- **Sparse least squares by conjugate gradients: a comparison of preconditioning methods**
  M.
  edited by J.
  University of Waterloo, Waterloo, Ontario, Canada

- **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

- **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.
  2016; 54 (4): 595-606

- **Heart rate analysis by sparse representation for acute pain detection.** *Medical & biological engineering & computing*
  Tejman-Yarden, S., Levi, O., Beizerov, A., Parmet, Y., Nguyen, T., Saunders, M., Rudich, Z., Perry, J. C., Baker, D. G., Moeller-Bertram, T.
  2016; 54 (4): 595-606

- **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

- **A Practical Factorization of a Schur Complement for PDE-Constrained Distributed Optimal Control** *JOURNAL OF SCIENTIFIC COMPUTING*
  Choi, Y., Farhat, C., Murray, W., Saunders, M.
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- **Do genome-scale models need exact solvers or clearer standards?** *MOLECULAR SYSTEMS BIOLOGY*
  Ebrahim, A., Almaas, E., Bauer, E., Bordbar, A., Burgard, A. P., Chang, R. L., Draeger, A., Famili, I., Feist, A. M., Fleming, R. T., Fong, S. S., Hatzimanikatis, V., Herrgard, et al
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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*
  Yang, L., Tan, J., O'Brien, E. J., Monk, J. M., Kim, D., Li, H. J., Charusanti, P., Ebrahim, A., Lloyd, C. J., Yurkovich, J. T., Du, B., Dräger, A., Thomas, et al
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  Yang, L., Tan, J., O'Brien, E. J., Monk, J. M., Kim, D., Li, H. J., Charusanti, P., Ebrahim, A., Lloyd, C. J., Yurkovich, J. T., Du, B., Draeger, A., Thomas, et al
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- **Study of liquid-phase molecular packing interactions and morphology of fatty acid methyl esters (biodiesel).** *Biotechnology for biofuels*
  Berman, P., Meiri, N., Colnago, L. A., Moraes, T. B., Linder, C., Levi, O., Parmet, Y., Saunders, M., Wiesman, Z.
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  Choi, S. T., Saunders, M. A.

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- **LSRN: A PARALLEL ITERATIVE SOLVER FOR STRONGLY OVER- OR UNDERDETERMINED SYSTEMS** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
  Meng, X., Saunders, M. A., Mahoney, M. W.
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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 : a publication of the Society for Industrial and Applied Mathematics*
  Meng, X., Saunders, M. A., Mahoney, M. W.
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- **PROXIMAL NEWTON-TYPE METHODS FOR MINIMIZING COMPOSITE FUNCTIONS** *SIAM JOURNAL ON OPTIMIZATION*
  Lee, J. D., Sun, Y., Saunders, M. A.
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- **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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- **MINRES-QLP: A KRYLOV SUBSPACE METHOD FOR INDEFINITE OR SINGULAR SYMMETRIC SYSTEMS** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
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- **Nonconservative Robust Control: Optimized and Constrained Sensitivity Functions** *IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY*
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- **STABILIZING POLICY IMPROVEMENT FOR LARGE-SCALE INFINITE-HORIZON DYNAMIC PROGRAMMING** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
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- **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.
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- **A globally convergent linearly constrained Lagrangian method for nonlinear optimization** *SIAM JOURNAL ON OPTIMIZATION*
  Friedlander, M. P., Saunders, M. A.
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- **A bisection algorithm for the mixed mu upper bound and its supremum** *American Control Conference*
  Fransson, C. M., Saunders, M. A.
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- **Subspace preconditioned LSQR for discrete ill-posed problems** *Conference on Computational Linear Algebra with Applications*
  Jacobsen, M., Hansen, P. C., Saunders, M. A.
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- **SNOPT: An SQP algorithm for large-scale constrained optimization** *SIAM JOURNAL ON OPTIMIZATION*
  Gill, P. E., Murray, W., Saunders, M. A.
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- **Global controller optimization using Horowitz bounds**
  Fransson, C., M., Lennartson, B., Wik, T., Holmstrom, K., Saunders, M., Gutman, P., O.
  2002

- **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.
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- **SNOPT: A Fortran software package to solve large-scale optimization problems**
  Gill, P., E., Murray, W., Saunders, M., A.
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- **OSSE mapping of galactic 511 keV positron annihilation line emission** *ASTROPHYSICAL JOURNAL*
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- **Computing projections with LSQR** *BIT NUMERICAL MATHEMATICS*
  Saunders, M. A.
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- **Non-parametric estimates of high energy gamma-ray source distributions** *4th Compton Symposium*
  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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- **SQP methods for large-scale optimization**
  Gill, P., E., Murray, W., Saunders, M., A.
  1996
- **On the stability of Cholesky factorization for symmetric quasidefinite systems** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
  Gill, P. E., Saunders, M. A., Shinnerl, J. R.
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- **Solution of sparse rectangular systems using LSQR and Craig** *BIT NUMERICAL MATHEMATICS*
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- **Primal-dual methods for linear programming** *MATHEMATICAL PROGRAMMING*
  Gill, P. E., Murray, W., PONCELEON, D. B., Saunders, M. A.
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- **A PRACTICAL INTERIOR-POINT METHOD FOR CONVEX-PROGRAMMING** *SIAM JOURNAL ON OPTIMIZATION*
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- **MINOS(IIS) version 4.2: Analyzing infeasibilities inlinear programming** *Eur. J. Oper. Res.*
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- **THE SIMPLEX ALGORITHM WITH A NEW PRIMAL AND DUAL PIVOT RULE** *OPERATIONS RESEARCH LETTERS*
  Chen, H. D., Pardalos, P. M., Saunders, M. A.
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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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- **Large-scale SQP methods and their applicationin trajectory optimization** *Control Applications of Opti-mization*
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- **Major Cholesky would feel proud** *ORSA J. Comput.*
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- **Some theoretical properties of an augmented Lagrangian merit function** *Advances in Optimization and Parallel Computing*
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- **2 CONJUGATE-GRADIENT-TYPE METHODS FOR UNSYMMETRIC LINEAR-EQUATIONS** *SIAM JOURNAL ON NUMERICAL ANALYSIS*
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