

CURRICULUM VITAE

Suvrajeet Sen

Education

B.E.(Hons.) Mechanical Engineering, Birla Inst. of Tech. and Sci. Pilani, India, 1977
M.E. Engineering Management, University of Louisville, Louisville, KY, 1979
Thesis: “Design of a multicommodity distribution network”
(Advisor: S.M. Alexander).
Ph.D. Industrial Engineering and Operations Research, VPI & SU, 1982
Dissertation: “The extreme point mathematical programming problem”
(Advisor: H.D. Sherali).

Major Field

Modeling and Optimization

Modeling: Telecommunications, power systems, transportation, and manufacturing
Optimization: Linear, nonlinear, large scale and stochastic optimization.

Employment

1981 - 1982 *Research Associate*,
Dept. of IMSE, Pennsylvania State University
1982 - 1987 *Assistant Professor*,
SIE Dept. University of Arizona
1987 - 1994 *Associate Professor*,
SIE Dept. University of Arizona
1994 - *Professor*,
SIE Dept. University of Arizona
Sabbaticals 1987-88 (Bellcore, Stanford Univ.)
1995-96 (Oak Ridge Nat. Labs., Univ. of Zurich)
2003 (EPSRC (U.K.) Funded Visitor to Brunel University, London)
2003 - 2005 *Program Director*, OR and SEE
Div. of Design, Manufacture and Industrial Innovation
National Science Foundation
2004 - 2005 *Chair*, NSF/Engineering Cyberinfrastructure Working Group
National Science Foundation

College and Departmental Service (most significant)

Member, SIE Peer Review Committee, (1994 - 98)
Leader, ELITE Project Team (1996 - 98)
Member, SIE Undergraduate Committee (1996 - 2000)
Chair, Arizona Software Institute, 1998 - 99.

Chair, of the SIE Search Committee, 1997 - 2001
 Organizer, SIE Seminar Series, 2000-2002
 Member, College Promotion and Tenure Committee (2000 - 2002)

University-wide Service (most significant)

Member, Program Assessment and Instructional Priorities Team.
 Affiliate Member, Program in Applied Mathematics (1989 -)
 Member, Search Committee for Digital Arts Director, Fine Arts College (1998-2000)
 Member, Committee for Information Technology Initiative (Prop. 301)

Extramural Service

Area Editor (Optimization), *Operations Research* (1996 - 2000)
Associate Editor, *Operations Research* (1991 - 1995), (2003 - date)
Associate Editor, *ORSA Journal on Computing*, (1995 - 2001)
Associate Editor, *J. of Telecommunications Systems*, (1996 - 2001)
Guest Editorships:, special issues of *Interfaces*, *Annals of Operations Research*, *IIE Transactions*, *Computational Optimization and Applications*.
General Chair NSF Tutorials on Stochastic Programming, 1996.
General Chair IFIP Workshop on Stochastic Programming, 1996.
Program Chair, INFORMS Telecommunications Conference, Boca Raton, FL, 1998.
General Chair, Tenth Conference on Stochastic Programming, October 2004.
Founder INFORMS Optimization Section, 1995.
Chair INFORMS (formerly ORSA/TIMS) Telecommunications Technical Section, 1995-96. (Chair-Elect: 1994-95).
Member INFORMS Strategic Planning Committee, 2004
Member Committee on Stochastic Programming (COSP) (by invitation), 2000-2004.
Member IFIP Working Group 7.7 (by invitation)
Program Co-Chair, ORSA/TIMS Meeting, Phoenix, 1993.
Member of Program Committee for ORSA Telecommunications Conference, 1995.
Member of International Program Committee for Conferences on Stochastic Programming, Israel (1995), Vancouver (1998), Berlin (2001).
External Examiner, University of South Africa (1991), Massey University, New Zealand (1994), University of Zurich, Switzerland (1995), University of Copenhagen, Denmark (1998), University of Rome (2001-2002).

Referee

National Science Foundation (Panelist), National Research Council (National Academy of Eng.), Australian Research Council, NSERC (Canada), International Science Foundation (for former Eastern Block nations) and the following journals
Annals of Operations Research, *Computational Optimization and Applications*, *European Journal of Operations Research*, *IEEE Transactions on Automatic Control*, *IIE Transactions*, *Interfaces*, *Journal of Design and Manufacturing*, *Journal of Global Optimization*, *Journal of Network and Systems Management*, *Journal of Economic Dynamics and Control Large Scale Systems*, *Management Science*, *Mathematical Programming*, *Mathematics of Operations Research*, *Naval Research Logistics Quarterly*, *Networks*, *ORSA Journal on Computing*, *Operations Research*, *Optimal Control Ap-*

plications and Methods, Production Planning and Control, Power Systems Computing, SIAM Journal on Control and Optimization, SIAM Journal on Optimization, Telecommunications Systems.

Referee for P&T at the following Universities

California-Davis, Colorado, Florida, Georgia Tech., Louisiana State University, Missouri, Penn State, Southern California, Texas, Washington

Invited Speaker at the following Universities

Arizona State University, British Columbia (Vancouver, Canada), Brunel (U.K), Univ. at Buffalo (SUNY Buffalo), UC-Davis, Cambridge (U.K), Charles Univ. (Prague, Czech), Copenhagen (Denmark), Florida, Georgia Tech., Groningen (Netherlands), Humboldt University (Berlin, Germany), Illinois, Lehigh, Louisville, Maryland, Michigan, Milan (Italy), Missouri-Rolla, Naval Postgraduate School, Northern Arizona, NC State, North Carolina, Northwestern, Oslo (Norway), Rome (Italy), St. Gallen (Switzerland), Norwegian Univ. of Science and Tech. (Trondheim, Norway), Penn State, Stanford, Stevens, Texas A&M, Tennessee, VPI, Zurich

(A) Publications

Archival Journals (AA), Books and Edited Volumes (AB), Proceedings (AC)

- [AC.1] F.H. Murphy, S. Sen and A.L. Soyster, "Accounting for uncertain load forecasts in electric utility capacity expansion: a deterministic equivalence," *Proceedings of Energy Modeling III*, Institute of Gas Technology, Chicago, Il. pp. 71-98, 1980.
- [AA.2] F.H. Murphy, S. Sen and A.L. Soyster, "Electric utility capacity expansion planning with uncertain load forecasts," *AIIE Transaction*, **14**, pp. 52-59, 1982.
- [AA.3] H.D. Sherali, A.L. Soyster, F.H. Murphy and S. Sen, "Linear programming based analysis of marginal cost pricing in electric utility capacity expansion," *European Journal of Operations Research*, **11**, pp. 349-360, 1982.
- [AA.4] H.D. Sherali, A.L. Soyster, F.H. Murphy and S. Sen, "Allocation of capital costs in electric utility capacity expansion planning under uncertainty," *Management Science* **30**, pp. 1-19. 1984.
- [AA.5] S. Sen, S.K. Saraf, A.L. Soyster, F.H. Murphy, "The capital supply curve in models of capacity expansion: some economic and algorithmic aspects," *Naval Research Logistics Quarterly*, **31**, pp. 199-212, 1984.
- [AA.6] S. Sen and H.D. Sherali, "On the convergence of cutting plane algorithms for a class of nonconvex mathematical programs," *Mathematical Programming*, **31**, pp. 42-56, 1985.
- [AA.7] S. Sen and H.D. Sherali, "A disjunctive cutting plane algorithm for the extreme point mathematical programming problem," *Opsearch*, **22**, pp. 83-94, 1985.
- [AA.8] S. Sen and H.D. Sherali, "A branch and bound algorithm for extreme point mathematical programming," *Discrete Applied Mathematics*, **11**, pp. 265-280, 1985.
- [AA.9] H.D. Sherali and S. Sen, "On generating cutting planes from combinatorial disjunctions," *Operations Research*, **33**, pp. 928-933, 1985.

- [AC.10] S. Sen and D.N. Contractor, "Reduction of fluid transients by minimax optimization," *Forum on Unsteady Flow*, ASME Winter Meeting, November 1985.
- [AC.11] S. Sen and A. Whiteson, "A cone splitting algorithm for reverse convex programming," *Proceedings of IEEE Conference on Systems Man and Cybernetics*, Tucson, AZ, pp. 656-660, 1985.
- [AA.12] S. Sen and H.D. Sherali, "Facet inequalities from simple disjunctions in cutting plane theory," *Mathematical Programming*, **34**, pp. 72-83, 1986.
- [AA.13] S. Sen and H.D. Sherali, "A class of convergent primal-dual subgradient algorithms for nondifferentiable optimization," *Mathematical Programming*, **35**, pp. 279-297, 1986.
- [AA.14] S. Sen, "A class of algorithms for large scale nonlinear minimax optimization," *Applied Mathematics and Computation*, **18**, pp. 355-361, 1986.
- [AA.15] S. Sen and D.N. Contractor, "Reduction of pressure surges by minimax optimization," *Applied Mathematical Modelling*, **10**, pp. 271-277, 1986.
- [AA.16] S. Sen and D. Yakowitz, "A primal-dual subgradient method for time staged capacity expansion," *European Journal of Operational Research*, **27**, pp. 301-312, 1986.
- [AA.17] F.H. Murphy, S. Sen and A.L. Soyster, "Electric utility expansion planning in the presence of existing capacity: a nondifferentiable convex programming approach," *Computers and Operations Research*, **14**, pp. 19-31, 1987.
- [AA.18] S. Sen and H.D. Sherali, "Nondifferentiable reverse convex programs and facetial cuts via a disjunctive characterization," *Mathematical Programming*, **37**, pp. 169-183, 1987.
- [AA.19] S. Sen and S.J. Yakowitz, "A Quasi-Newton algorithm for discrete-time optimal control," *Automatica*, **23**, pp. 749-752, 1987.
- [AA.20] A. Rakshit, S. Sen and L. Duckstein, "A Stagewise Compromise Programming Framework for Multi-stage Multiple Objective Decision Making Problems," *Control Theory and Advanced Technology*, special issue on Multi-objective Discrete Dynamic Systems (Y. Haimes, editor), **5**, pp. 413-441, 1989
- [AC.21] S. Sen, R.D. Doverspike and S.I. Vohnout, "Diverse Routing in the Unified Facilities Optimizer," *Proceedings of Global Telecommunications Conference (Globe-com)*, 1989.
- [AC.22] A. Vakharia, R.G. Askin and S. Sen, "Cell Formation in Group Technology: A Mathematical Programming Approach," *Proceedings of the Decision Sciences Institute Annual Meeting*, 1989.
- [AA.23] A. Rakshit and S. Sen, "Sequential rank-one/rank-two updates for quasi-Newton differential dynamic programming," *Optimal Control Applications and Methods*, **11**, pp. 95-101, 1990.
- [AA.24] J.L. Higle and S. Sen, "Stochastic Decomposition: An algorithm for two stage linear programs with recourse," *Math. of Operations Research*, **16**, pp. 650-669, 1991.

- [AA.25] J.L. Hige and S. Sen, "Statistical verification of optimality conditions for stochastic programs with recourse," *Annals of Operations Research*, **30**, pp. 215-240, 1991.
- [AA.26] J.L. Hige and S. Sen, "On the convergence of algorithms with implications for stochastic and nondifferentiable optimization," *Math. of Operations Research*, **17**, pp. 112-131, 1992.
- [AA.27] S. Sen, "Relaxations for probabilistically constrained programs with discrete random variables," *Operations Research Letters*, **11**, pp. 81-86, 1992.
- [AA.28] S. Sen, "Subgradient decomposition and the differentiability of the recourse function of a two stage stochastic LP with recourse," *Operations Research Letters*, **13**, pp. 143-148, 1993.
- [AC.29] S. Sen and L. Mahajan, "A Model for Multiplexing and Cable Sizing in Local Access Telephone Networks," *Annual Communications Review*, **47**, pp. 530-537, 1993.
- [AC.30] J.L. Hige and S. Sen, "Stochastic Decomposition: A Statistical Approach to Activity Analysis Under Uncertainty," Proceedings of the IFIP/Daimler-Benz Workshop on "Statistical Methods for Decision Processes", (G. Hellwig, P. Abel and P. Kall eds.) pp. 64-77, 1993.
- [AA.31] K.T. Au, J.L. Hige and S. Sen, "Inexact subgradient methods with applications in stochastic programming," *Mathematical Programming*, **63**, pp. 65-82, 1994
- [AA.32] M.S. Sodhi, R.A. Askin, S. Sen, "Multiperiod tool and production assignment in Flexible Manufacturing Systems," *Int. J. of Prod. Research*, **32**, pp. 1281-1294, 1994.
- [AA.33] S. Sen, J. Mai and J.L. Hige, "Solution of Large Scale Stochastic Programs with Stochastic Decomposition Algorithms," Book Chapter for *Large Scale Optimization: The State of the Art*, W. Hager, D. Hearn and P. Pardalos (eds.)
- [AA.34] S. Sen, R.D. Doverspike and S. Cosares, "Network Planning with Random Demand," *Telecommunication Systems*, **3**, pp. 11-30, 1994.
- [AA.35] J.L. Hige and S. Sen, "Epigraphical Nesting: a unifying theory for the convergence of algorithms," *Journal of Optimization Theory and Applications*, **84**, pp. 339-360, 1995.
- [AA.36] M.S. Sodhi, R.A. Askin and S. Sen, "A hierarchical model for flexible manufacturing systems control," *Journal of Operational Research*, **45**, pp. 1185-1196, 1994.
- [AA.37] J.L. Hige and S. Sen, "Finite master programs in stochastic decomposition," *Mathematical Programming*, **67**, pp. 143-168, 1994.
- [AA.38] J.L. Hige and S. Sen, "Statistical Approximations for Recourse Constrained Stochastic Programs," *Annals of Operations Research*, **56**, pp. 157-175, 1995.
- [AA.39] J.L. Hige and S. Sen, "Duality and Statistical Tests of Optimality for Two Stage Stochastic Programs," *Mathematical Programming*, **75**, pp. 257-275, 1996.
- [AB.40] J.L. Hige and S. Sen, *Stochastic Decomposition: A Statistical Method for Large Scale Stochastic Linear Programming*, Kluwer Academic Publishers, Dordrecht,

1996.

- [AB.41] S.W. Wallace, J.L. Hige and S.Sen (eds). *Stochastic Programming, Algorithms and Models*, special issue of *Annals of Operations Research*, **64**, 1996.
- [AC.42] J.L. Hige and S. Sen, "Tutorial: Modeling Two Stage Stochastic Linear Programs," *Proceedings of the Industrial Engineering Research Conference*, pp. 311-320, 1996.
- [AC.43] S. Sen, J.L. Hige, J.B. Goldberg and W.R. Ferrell, "Engineering with a Liberal and Technical Education (ELITE)," *Proceedings of Frontiers in Education Conference*, Salt Lake City, UT, 1996.
- [AC.44] S. Sen, J.B. Goldberg, J.L. Hige and W.R. Ferrell, "Bachelor of Arts in Engineering: Endless Possibilities," *Proceedings of the ASEE-PSW Conference*, San Luis Obispo, CA, 1997.
- [AA.45] S. Sen and K.L. Head "Controlled Optimization of Phases (COP) at an Intersection," *Transportation Science*, **31**, pp. 5-17, 1997.
- [AA.46] H.D. Sherali, G. Choi and S. Sen, "An exterior-point polytope sliding method for linear programming," *Informatica*, **8**, pp. 559-582, 1997.
- [AA.47] S. Sen and J.L. Hige, "An Introductory Tutorial on Stochastic Linear Programming: Modeling," *Interfaces*, **29**, pp. 33-61, 1999.
- [AA.48] J.L. Hige and S. Sen, "Statistical approximations for stochastic linear programming problems," *Annals of Operations Research*, **85**, pp. 173-192, 1999.
- [AC.49] J.L. Hige and S. Sen, "Algorithmic Implications of Duality in Stochastic Programs," *Proceedings of the IFIP Conference*, 1999.
- [AA.50] S. Sen, J.L. Hige and J.R. Birge, "Duality Gaps in Stochastic Integer Programming," *Journal of Global Optimization*, **18**, pp. 189-194, 2000.
- [AC.51] Y.K. Cho, B.P. Zeigler, H.J. Cho, H.S. Sarjoughian and S. Sen, "Design Considerations for Distributed Real-time DEVS," *Proceedings of AIS 2000*.
- [AA.52] S. Sen, R. Pillai, S. Joshi, A. Rathi, "A Mean-Variance Model for Route Guidance in Advanced Traveller Information Systems," *Transportation Science*, **35**, pp. 37-49, 2001.
- [AA.53] J. Wu and S. Sen, "A Stochastic Programming Model for Currency Option Hedging," *Annals of Operations Research*, **100**, pp. 227-250, 2000.
- [AB.54] F.H. Murphy and S. Sen, "Qualitative Implications of Uncertainty in Economic Equilibrium Models," *Decision-Making Under Uncertainty: Energy and Power*, (C. Greengard and A. Ruszczyński, eds.), The IMA Volumes in Mathematics and its Applications, vol. 128, Springer, New York, 2002.
- [AC.55] S. Sen, A. Dixit, Y. Xu, A.L. Barath and F. Ciarallo, "The Open Bit Mine: A Laboratory Test-bed for Studying Parallel Realities," *Proceedings of IE Research Conference*, May 2001.
- [AB.56] J.L. Hige and S. Sen, "Stochastic Linear Programming: Decomposition and Cutting Planes," *Encyclopedia of Optimization*, (C.A. Floudas and P.M. Pardalos, eds.), Kluwer Academic Publishers, Dordrecht, 2001.

- [AB.57] S. Sen and J.L. Hige, "Stabilization of Cutting Plane Algorithms for Stochastic Linear Programming Problems," *Encyclopedia of Optimization*, (C.A. Floudas and P.M. Pardalos, eds.), Kluwer Academic Publishers, Dordrecht, 2001.
- [AB.58] S. Sen, "Stochastic Programming," *Encyclopedia of Operations Research and Management Science* (S. Gass and C. Harris, eds.), pp. 784 - 789, Kluwer Academic Publishers, Dordrecht, 2001.
- [AB.59] J.L. Hige and S. Sen, "A Stochastic Programming Model for Network Resource Utilization in the Presence of Multi-Class Demand Uncertainty," to appear in *Applications of Stochastic Programming* (eds. S.W. Wallace and W.T. Ziemba).
- [AC.60] S. Sen, L. Yu and T. Genc, "Decision Aids for Scheduling and Hedging in Deregulated Electricity Markets: A Stochastic Programming Approach to Power Portfolio Optimization," (invited paper), *Proceedings of the 2002 Winter Simulation Conference*, San Diego, CA.
- [AB.61] G. Lulli and S. Sen, "Stochastic Batch Sizing Problems: Models and Algorithms," *Stochastic Integer Programming and Network Interdiction Models* (D.L. Woodruff ed.), pp. 85 - 103, Kluwer Academic Press, 2002.
- [AB.62] S. Sen, J.L. Hige and L. Ntamo, "A Summary and Illustration of Disjunctive Decomposition with Set Convexification," *Stochastic Integer Programming and Network Interdiction Models* (D.L. Woodruff ed.), pp. 105 - 125, Kluwer Academic Press, 2002.
- [AA.63] G. Lulli and S. Sen, "A Branch and Price Algorithm for Multi-stage Stochastic Integer Programs with Applications to Stochastic Lot Sizing Problems," *Management Science*, **50**, pp. 786-796, 2004.
- [AA.64] Y. Xu, S. Sen and F. Ciarallo, "An Agent-based Approach for Distributed Simulation," *International Journal of Modeling and Simulation*, **24**, no. 2, pp. 55-64, 2004.
- [AA.65] J.L. Hige and S. Sen "Duality for Multistage Convex Stochastic Programs," to appear in *Annals of Operations Research*.
- [AB.66] S. Sen, "Algorithms for Stochastic Mixed-Integer Programming Models," *Handbook of Discrete Optimization*, (K. Aardal, G.L. Nemhauser, and R. Weismantel eds.), North-Holland Publishing Co., pp. 515-558, 2005.
- [AA.67] L. Ntamo and S. Sen, "The Million Variable "March" for Stochastic Combinatorial Optimization," *Journal of Global Optimization*, **32**, no. 3, 2005.
- [AA.68] S. Sen, L. Yu, and T. Genc, "A Stochastic Programming Approach to Power Portfolio Optimization," to appear in *Operations Research*.
- [AA.69] M. Casey and S. Sen, "The Scenario Generation Algorithm for Multi-stage Stochastic Linear Programming," *Mathematics of Operations Research*, **30**, pp. 615-631, 2005.
- [AA.70] G. Lulli and S. Sen, "A Heuristic Algorithm for Stochastic Integer Programming with Complete Recourse," to appear in *European J. of Operations Research*.
- [AA.71] S. Sen and J.L. Hige "The C^3 Theorem and a D^2 Algorithm for Large Scale Stochastic Integer Programming," *Mathematical Programming*, **104**, pp. 1-20,

2005.

- [AA.72] S. Sen and H.D. Sherali, “Decomposition with Branch-and- Cut Approaches for Two Stage Stochastic Integer Programming,” to appear in *Mathematical Programming*.
- [AC.73] Y. Xu and S. Sen, “A Distributed Computing Architecture for Simulation and Optimization,” Proceedings of the Winter Simulation Conference (M.E. Kuhl, N.M. Steiger, F.B. Armstrong, J.A. Jones, eds.), December 2005.
- [AA.74] T. Genc, S. Reynolds, and S. Sen, “Dynamic Oligopolistic Games Under Uncertainty: A Stochastic Programming Approach,” to appear in *Journal of Economic Dynamics and Control*.
- [AC.75] S. Sen “On Bridging the Gap between Academe and Industry in OR/MS,” to appear in *OR/MS Today* (A Professional Magazine).

(B) Papers under review

- [B.1] J.L. Higle, B. Rayco, and S. Sen “Stochastic Scenario Decomposition for Multi-stage Stochastic Programs,” submitted to *Annals of Operations Research*.
- [B.2] Y. Xu and S. Sen, “The Parallel Reality Framework for Dynamic Data Driven Simulations,” submitted to *ACM Trans. on Modeling and Simulation*.
- [B.3] L. Ntaimo and S. Sen, “A Comparative Study of Decomposition Algorithms for Stochastic Combinatorial Optimization,” submitted to *INFORMS J. on Computing*.

(C) Scholarly Presentations

Major Invitations

- [C.1] Semi-plenary Lecture on ‘Stochastic Decomposition algorithms for stochastic linear programming’, International Conference on Operations Research, Berlin, 1994. (This conference, organized by German speaking OR societies, has one featured lecture for per track. They call this a semi-plenary lecture.)
- [C.2] Featured Lectures on ‘Advances in Stochastic Programming,’ Dutch Operations Research Conference, January 2000. (This is a series of 3 lectures at the conference.)
- [C.3] Plenary Lecture on ‘Algorithmic Challenges in Stochastic Programming,’ Ninth International Conference on Stochastic Programming, August 2001.
- [C.4] Distinguished Lecture on ‘The SPEED-CS Project,’ Speed Scientific School, Univ. of Louisville, Nov. 2001.
- [C.5] Distinguished Lecture at Penn State University, September 2004.
- [C.6] Report on ‘Structuring Cyberinfrastructure for the Engineering Directorate,’ presented as Chair of the Engineering Cyberinfrastructure Working Group, August

2005.

- [C.7] Keynote Lecture ‘Service Enterprise Engineering,’ First IEEE-Service Operations, Logistics and Transportation Conf. Beijing, China, August 11, 2005.
- [C.8] Opening Keynote Lecture ‘Operations Research: The Glue for Infrastructure Systems,’ Operations Research Society of India National Meeting, Bangalore, India, December 2005.

Research Tutorials

- [C.6] Tutorial on ‘Large Scale Optimization Under Uncertainty,’ ORSA/TIMS Conference, Boston, 1994.
- [C.7] Tutorial on ‘Algorithms for Stochastic Programming,’ INFORMS (formerly ORSA/TIMS) Conference, New Orleans, 1995.
- [C.8] Tutorial on ‘Algorithms for Large Scale Stochastic Programming,’ INFORMS Computer Science Technical Section Meeting (formerly ORSA/TIMS) Monterey, CA, 1998.
- [C.9] Tutorial on ‘Scenario Generation in Stochastic Programming,’ INFORMS Conference, Cincinnati, OH, May 1999.
- [C.10] Tutorial on ‘Stochastic Integer Programming,’ INFORMS Conference, Salt Lake City, UT, May 2000
- [C.11] Tutorial on ‘Stochastic Integer Programming,’ INFORMS Conference, Maui, Hawaii, June 2001.

Lectures at Academic Institutions and Industry

- [C.12] ‘Multiplexing considerations in network planning,’ *Bell Communications Research*, May 1989.
- [C.13] ‘Stochastic Decomposition: A new algorithmic concept for stochastic programming,’ March 1987, presented at
 - (a) *RPI*, Decision Sciences and Systems Engineering Dept.
 - (b) *Penn State*, IE Dept.
 - (c) *Bell Communications Research*.
- [C.14] ‘Primal-Dual methods in Lagrangian Relaxation,’ *Martin Marietta Information and Communications Systems*, June 1987.
- [C.15] ‘Algorithms for the Unified Facilities Optimizer,’ presented at
 - (a) *Purdue*, IE Dept., March 1988.
 - (b) *Univ. of Ariz.* Elect. and Comp. Eng. Dept, Nov. 1989.
- [C.16] ‘Planning CIM Systems,’ *Diversified Engineering*, October, 1989.
- [C.17] ‘Integrating Dynamic Routing in Link Sizing,’ *Deutsche Bundespost*, Darmstadt, Germany, July 1991.
- [C.18] ‘Progress on Stochastic Decomposition Algorithms,’ presented at
 - (a) *Stanford Optimization Laboratory*, Feb. 1989.

- (b) *Pacific Gas and Electric Co.*, March, 1989.
 - (c) *Bell Communications Research*, April 1989.
 - (d) *Southern Methodist University*, November 1989.
 - (e) *Nat. Institute of Standards and Tech.*, November 1990
 - (f) *Bell Communications Research*, March 1991.
 - (g) Minisymposium at *Humboldt University*, Berlin, Germany, January 1994.
 - (h) *University of British Columbia*, Vancouver, B.C, February 1994.
 - (i) *Naval Postgraduate School*, Monterey, February, 1994.
 - (j) *The University at Buffalo*, April 2001
- [C.19] ‘Activity Analysis Under Uncertainty’, presented at
- (a) *Systems Science Seminar, Arizona State University*, April, 1992.
 - (b) *Bell Communications Research*, May, 1992.
 - (c) *Daimler Benz*, Stuttgart, Germany, June 1992.
 - (d) *AT & T Bell Laboratories*, August 1992
 - (e) *U.S. West Advanced Technologies*, December 1992
- [C.20] ‘Computational considerations in the solution of large scale stochastic programs using Stochastic Decomposition algorithms,’ presented at
- (a) 24th Optimization Conf. organized by *Charles University*, Prague, Czech., Sept. 1992.
 - (b) Conference on Large Scale Optimization, organized by *The University of Florida*, February 1993.
 - (c) *Pacific Gas and Electric Co.*, March, 1993.
- [C.21] ‘Verification of Optimality in Sampling-based Algorithms,’ presented at
- (a) Workshop at the *Intl. Inst. for Appl. Systems Analysis (IIASA)*, Laxenburg, Austria, July 1993.
 - (b) *Bell Communications Research*, May 1994.
- [C.22] ‘Multi-stage Stochastic Decomposition Algorithms,’ presented at
- (a) *University of California, Davis*, March 1995
 - (b) *Humboldt University, Berlin, Germany*, March 1996
- [C.23] ‘Controlled Optimization of Phases (COP) at an Intersection,’ presented at
- (a) *Univ. of Tennessee, Knoxville, TN*, Sept. 1995
 - (b) *Univ. of Louisville, Louisville, KY*, Oct. 1995
 - (c) *Charles University, Prague, Czech Rep.*, Feb. 1996
 - (d) *University of Copenhagen, Denmark*, March, 1996
- [C.24] ‘A Mean-Variance Approach in Advanced Traveller Information Systems,’
- (a) *Cambridge University*, Cambridge, England
- [C.25] ‘On connections between stochastic programming, simulation optimization and design optimization,’ *NASA Langley*, Hampton, VA, July 1998.
- [C.26] ‘A Scenario Generation Algorithm for Stochastic Programming,’ presented at
- (a) *University of Florida*, February 1999
 - (b) *University of British Columbia*, March 1999
 - (c) *Texas A & M University*, April 1999

- (d) *University of Oslo, Norway*, March 2001
- [C.27] ‘Qualitative Implications of Uncertainty in Economic Equilibrium Models,’
 (a) *Univ. of Copenhagen*, November 1998
 (b) *Univ. of California, Riverside*, May 1999
 (c) *Electric Power Research Inst.*, July 1999
- [C.28] ‘The SPEED-CS Project’
 (a) *Univ. of Louisville*, November 2001
 (b) *NSF Workshop, University of Texas*, March 2002
- [C.29] ‘Algorithmic Challenges in Stochastic Programming’
 (a) *Arizona State University*, February 2002
 (b) *Penn State University*, February 2002
 (c) *Georgia Tech.*, April 2002
- [C.30] ‘The Scenario Generation Algorithm for Multi-stage SLP’
 (a) *Johns Hopkins University*, October 2002
 (b) *CGDO Conference*, Blacksburg, August, 2005.
- [C.31] ‘Research Trails in Operations Research,’
 (a) *National Science Foundation*, February 2003
 (b) *Brunel University*, March 2003.

(D) Invited Conference Presentations (only 2000 onwards)

- [D.1] ‘Connections between Stochastic Programming and Hierarchical Planning,’ HOP Meeting, Vienna, Austria March 2000.
- [D.2] ‘Data Evolution Modeling,’ INFORMS Conference, Salt Lake City, UT, May 2000.
- [D.3] ‘Sequential Convexification for Stochastic Integer Programs,’ Seventeenth ISMP, Atlanta, Aug. 2000.
- [D.4] ‘Branch and Price Algorithms for Stochastic Integer Programming,’ INFORMS Conference, San Antonio, TX, Nov 2000. (Also presented at University of Oslo)
- [D.5] ‘The SPEED-CS Project’ International Parallel and Distributed Processing Symposium, CA, April 2001
- [D.6] ‘Advances in Traveler Information Systems,’ Conference on Decision-making under Uncertainty, Molde, Norway, May 2001.
- [D.7] ‘A Test Bed for Parallel Reality Modeling,’ Industrial Engineering Research Conference, Dallas, TX, May 2001.
- [D.8] ‘Branch and Cut Algorithms for Stochastic Integer Programs,’ INFORMS Conference, Miami, FL, Nov. 2001.
- [D.9] ‘The SPEED-CS Architecture,’ NSF Workshop on Next Generation Software, Univ. of Texas, Austin, TX, Feb. 2002
- [D.10] ‘The Scenarion Generation Algorithm,’ SIAM Optimization Conference, Toronto,

CA, May 2002, and INFORMS Conference San Jose, CA, Nov. 2002 (Presented by Michael Casey)

[D.11] ‘The DASH Model for Power Portfolio Optimization,’ INFORMS Conference, San Jose, CA, Nov. 2002, and the Winter Simulation Conference, San Diego, CA 2002 (Presented by T. Genc)

[D.12] ‘Nested Column Generation,’ INFORMS Conference, San Jose, CA, Nov. 2002 (Presented by L. Yu)

Grants and Contracts (S. Sen is the lead PI unless otherwise stated)

With the exception of three grants, I have served as the lead PI for all the other grants which total approximately \$3 million. Of these, I have been the lead PI for NSF grants totalling approximately \$2.25 million. Internal grants from the university are not listed below.

Bell Communications Research

Project: Intra-LATA network design with multiplexing considerations

Duration: Jan. 1984 - Dec. 1985 (\$75,000); Summer 1986.

Responsibility: 100%

AT&T

Distributed Algorithms (\$27,000 from AT&T).

Responsibility: 100%

Manufacturing Laboratory Development (Co-PI: R. Askin, \$26,000 from AT&T).

Responsibility: 50%

Bell Communications Research

Project: Unified Facilities Optimizer.

Duration: September 1986 - May 1989 (\$126,000).

Responsibility: 100%

U.S. West

Project: Network Planning under Uncertainty

Duration: June 1991-August 1992 (\$17,200)

Responsibility: 60%

Arizona Department of Transportation

Project: RHODES for Real-Time Traffic Control (PI: P. Mirchandani)

Involvement: May 1991-Feb 1992.

Responsibility: 15% of \$200,000.

National Science Foundation

Project: Mathematical Programming Under Uncertainty: Risk and Recourse Revisited. (Co-PI: J.L. Higle)

Duration: October 1991 - September 1994 (\$245,000).

Responsibility: 50%

NATO

Project: Cellular Decomposition (Co-PI's: J.L. Higle and S.W. Wallace)

Duration: January 1993 - August 1994 (\$4,000)

Responsibility: 33%

National Science Foundation

Project: Research Experience for Undergraduates. This grant is intended to supplement an earlier NSF grant.

Duration: December 1992 - August 1994 (\$5,000).

Responsibility: 100%

Federal Highway Administration

Project: Real-Time Traffic Control (PI: P. Mirchandani)

Duration: June 1994 - December 1995

Responsibility: 15% of \$375,000

National Science Foundation

Project: Integrated Planning Under Uncertainty: Statistical Methods in Mathematical Programming. (Co-PI: J.L. Higle)

Duration: November 1994 - October 1997 (\$301,921).

Responsibility: 50%

National Science Foundation

Project: Tutorials on Stochastic Optimization.

Duration: July 1995 - July 1996 (\$20,000).

Responsibility: 50%

Department of Education

Project: Graduate Assistance in Areas of National Need (GAANN, PI: P. Mirchandani)

Duration: September 1995 - July 2000 (\$500,000).

Responsibility: 20%

National Science Foundation

Project: ELITE: Engineering with Liberal and Technical Education. (Co-PIs: W.R. Ferrell, J.B. Goldberg, J.L. Higle)

Duration: June 1996 - June 2001 (\$700,000).

Responsibility: 40%

National Science Foundation

Project: SPEED-CS: A Simulation Platform for Experimentation and Evaluation of Distributed-Computing Systems. (Co-PIs: F. Ciarallo, H. Sarjoughian, R. Schlichting and B. Zeigler)

Duration: August 1999 - July 2003 (\$1 million).

Responsibility: 55%

National Science Foundation

Project: Performance Models with Data Evolution (Co-PI: J.L. Higle)

Duration: August 1999 - July 2002 (\$416,000).

Responsibility: 50%

Lockheed Martin

Project: Network Design and Simulation (Co-PI: J.C. Smith)

Duration: December 2000 - December 2001 (\$10,000).

Responsibility: 50%

Air Force Office of Scientific Research

Project: MURI for Human Decision Making (PI: J.C. Smith, 2003-2005), (PI: S. Sen, 2005 - 2008)

Duration: August 2003 - August 2008 (\$4,200,000).

Responsibility: 20%

Consulting

Consultant to *Bellcore, Diversified Engineering Inc., Modular Mining, Pinnacle West Capital Corporation, U.S. West Communications, United Airlines,*

Teaching

List of Courses (last 5 years)

Undergraduate Courses (Book used in parenthesis)

- (1) Computer Methods for Engineering (Yakowitz/Szidarovszky).
- (2) Deterministic Operations Research (Winston).
- (3) A Survey of Optimization Methods (Winston).
- (4) Concepts in Communications Systems (Kurose/Ross, Bertsekas/Gallagher).

Graduate Courses (Book used in parenthesis)

- (1) Linear Programming (Bertsimas)
- (2) Nonlinear Programming Algorithms (Bertsekas)
- (3) Distributed Algorithms (Lynch)
- (4) Topics in Optimization (Notes)
- (5) Large Scale Optimization (Notes).

Contributions to University Teaching

- (1) Applied Mathematics Brown Bag Lunch, 1990, 1994.
- (2) ATRP Brown Bag Lunch, 1991.
- (3) Applied Mathematics Case Studies Seminar, 1991, 1994, 1998.
- (4) MIS Seminar, 1999.
- (5) Statistics Seminar, 2002

Undergraduate Research Supervision

- [1] J. Mai (funded thru NSF grant) ‘Implementation of Stochastic Decomposition algorithms’ (Sept. 1991 - 1993)
- [2] C. Tomkins (ELITE student) ‘Water Resources Case Study’ (May 2001)

Graduate Research Supervision

My research program has involved a number of graduate students. As a measure of the quality of my students, it may be noted that several of my students (Sonia Vohnout, Jason Mai and Claire Tomkins) have been awarded NSF Graduate Fellowships. In addition, two students have been funded by European Governments to conduct graduate research under my supervision at Arizona.

Supervision of Exchange Students

- [1] T.S. Sund (funded by Norwegian Govt.) (1993-94).
- [2] G. Lulli (funded by Italian Govt.) (2001).

M.S. Theses and Reports

- [1] D.S. Yakowitz, 'Subgradient optimization methods for capacity expansion planning,' December 1983. (proceeded to finish a Ph.D at UA).
- [2] A. Whiteson, 'A cone splitting algorithm for reverse convex programming,' July 1985. (proceeded to join Sandia Labs.)
- [3] S. Bradley, 'Multiplexing considerations in the design of intra-LATA networks,' August 1985. (proceeded to join AT&T Bell Labs.)
- [4] F. Burstrom, 'Approximate methods for large scale fixed charge network flow problems,' August 1985. (proceeded to join AT&T Bell Labs)
- [5] M.S. Dunatunga, 'Successive two segment separable programming for large scale non-linear minimax optimization,' December 1985. (proceeded to finish a Ph.D at UA)
- [6] J. Gunn, 'Stochastic Decomposition,' May 1986. (proceeded to join Hughes)
- [7] D. Rushall, 'Heuristics for 3-Dimensional Collision Avoidance', May 1989. (proceeded to join General Dynamics)
- [8] S.I. Vohnout, 'Heuristics for diverse routing in telecommunications networks', May 1990. (proceeded to join IBM)
- [9] L. Murthy, 'A Multiplexing and Cable Sizing Model for Tree Networks,' (June 1993). (Employed with a software firm in Seattle.)
- [10] G. Cameron, 'A stochastic programming approach to network planning,' (Co-directed with J.L. Higle), December 1993.
- [11] J. Mai (M.S.) 'Cellular Decomposition', 1994. (joined Microsoft)
- [12] R. Balasubramaniam (M.S.) 'Statistical Tests of Optimality for Stochastic Linear Programming', 1996. (joined U.S. Air)
- [13] I. Hapugoda (M.S.) 'Dynamic Interactive Planning and Simulation,' (2002)

Ph.D. Dissertations

- [1] A. Rakshit (Ph.D) ‘A Framework For Discrete-Time Dynamic Programming with Multiple Objectives,’ October 1988. (Co-directed with L.D. Duckstein). (joined United Airlines)
- [2] M.S. Dunatunga, (Ph.D) ‘Stagewise methods for nondifferentiable dynamic optimization problems,’ May 1990. (joined Univ. of Arizona)
- [3] D.S. Yakowitz, (Ph.D) ‘Stochastic Decomposition for Some Nonlinear Stochastic Programs,’ Dec. 1990, (Co-directed with J.L. Hagle). (joined U.S. Geological Service)
- [4] M.S. Sodhi, (Ph.D.) ‘Hierarchical Methods for Manufacturing Systems Design,’ Feb. 1991 (Co-directed with Ron Askin). (joined Univ. of Rhode Island)
- [5] K.T. Au, (Ph.D.) ‘Inexact Subgradient Methods,’ March 1992, (Co-directed with J.L. Hagle).
- [6] J. Wu (Ph.D) ‘A Sampling Based Stochastic Programming Algorithm and Its Application to Currency Option Hedging,’ October 1996. (joined Fannie Mae)
- [7] S. Shelby (Ph.D) ‘Distributed Traffic Control,’ December 2001. (joined Gardner Transportation Systems)
- [8] G. Lulli (Ph.D) (Univ. of Rome), (S. Sen is the technical advisor.) (December 2002) (joined Univ. of Milan, Italy)
- [9] T. Genc (Ph.D, Economics) ‘Economics of Restructuring in Electricity Markets,’ (co-advised by S. Reynolds), December 2003 (joined Univ. of Guelph).
- [10] L. Yu (Ph.D) ‘Stochastic Optimization in Competitive Markets,’ May 2004. (joined PPL Inc.)
- [11] N. Lewis (Ph.D) ‘Stochastic Combinatorial Optimization’ July 2004 (joined Texas A&M)
- [12] Y. Xu (Ph.D) ‘Distributed Systems Simulation’ (August 2005) (joined Henwood Energy Systems)

Post-doctoral/Visiting Scholar Supervision

- [1] B. Rayco (Ph.D in ISE, Univ. of Florida), “Stochastic Scenario Decomposition,” (1997-98).
- [2] M. Casey (Ph.D in Math. Univ. of California-Davis), “Scenario Generation Algorithms,” (2001-2002).
- [3] J. Desai (Ph.D. in ISE, Virginia Tech.), “Survivable Network Design,” (2005-2006)
- [4] K. Huang (Ph.D. in ISyE, Georgia Tech. “Re-sampling in Stochastic Programming,” (2005-2006).