

REFERENCES

- Aly, Alaa, H. and Richard C. Peralta 1999 Comparison of a genetic algorithm and mathematical programming to the design of groundwater cleanup systems, *Water Resources Research*, 35(8), 2415-2425.
- Armstrong, M. 1984 Problems with Universal Kriging, *Mathematical Geology*, 16(1), 101-108.
- ASCE Task Committee on Geostatistical Techniques 1990a Review of Geostatistics in Geohydrology I: Basic Concepts, *Journal of Hydraulic Engineering*, 116(5), 612-632.
- ASCE Task Committee on Geostatistical Techniques 1990b Review of Geostatistics in Geohydrology II: Applications, *Journal of Hydraulic Engineering*, 116(5), 633-658.
- ASTM 1995 *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (E1739-95), American Society for Testing and Materials, West Conshohocken, PA.
- Aziz, J. J., C. J. Newell, H. S. Rifai, M. Ling, and J. R. Gonzales 2000 *Monitoring and Remediation Optimization System (MAROS): Software User's Guide*, Version 1, United States Air Force Center for Environmental Excellence, Brooks AFB: San Antonio, TX.
- Bäck, T. 1996 *Evolutionary Algorithms in Theory and Practice*, Oxford University Press: New York, NY.
- Barry, D. A. and G. Sposito 1990 Three-dimensional statistical moment analysis of the Stanford/Waterloo Borden tracer data. *Water Resources Research*, 26(8), 1735-1747.
- Bogaert, P. and D. Russo 1999 Optimal spatial sampling design for the estimation of the variogram based on a least squares approach, *Water Resources Research*, 35(4), 1275-1289.

- Buras, Nathan 2001 Water Resources—Unresolved Issues, *Journal of Water Resources Planning and Management*, 127(6), 353.
- Cameron, K. and P. Hunter 2000 Optimization of LTM Networks: Statistical Approaches to Spatial and Temporal Redundancy. Proceedings from the American Institute of Chemical Engineers, 2000 Spring National Meeting, Remedial Process Optimization Topical Conference, Atlanta, GA.
- Chilès, J. P. and P. Delfiner 1999 *Geostatistics: Modeling Spatial Uncertainty*, Wiley Series in Probability and Statistics, John Wiley & Sons, Inc., New York, NY.
- Chiueh, P. T., S. L. Lo, and C. D. Lee 1997 Prototype SDSS for using probability analysis in soil contamination, *Journal of Environmental Engineering*, 123, 514-519.
- Christakos, G. and R. A. Olea 1988 A multiple-objective optimal exploration strategy, *Mathematical and Computer Modeling*, 11, 413-418.
- Cieniawski, S. E. 1993 *An Investigation of the Ability of Genetic Algorithms to Generate the Tradeoff Curve of a Multi-Objective Groundwater Monitoring Problem*, Masters Thesis, University of Illinois: Urbana, IL.
- Cieniawski, S. E., J. W. Eheart, and S. Ranjithan 1995 Using genetic algorithms to solve a multiobjective groundwater monitoring problem. *Water Resources Research*, 31(2), 399-409.
- Coello, C. A. C. 1999 A comprehensive survey of evolutionary-based multiobjective optimization techniques. *Knowledge and Information Systems*, 1(3), 269-308.
- Cooper, R. M., and J. D. Istok 1988a Geostatistics applied to groundwater contamination I: Methodology, *Journal of Environmental Engineering*, 114(2), 270-285.

- Cooper, R. M., and J. D. Istok 1988b Geostatistics applied to groundwater contamination II: Application, *Journal of Environmental Engineering*, 114(2), 287-299.
- Cooper, R. M., and J. D. Istok 1988c Geostatistics applied to groundwater pollution III: Global Estimates, *Journal of Environmental Engineering*, 114(4), 915-928.
- Crawford, Carol Gotway and G. W. Hergert 1997 Incorporating Spatial Trends and Anisotropy in Geostatistical Mapping of Soil Properties, *Soil Sci. Soc. Am. J.*, 61, 298-309.
- Deb, K. and D. E. Goldberg, 1989 An investigation of niche and species formation in genetic function optimization. In J. D. Schaffer, ed. Proceedings of the Third International Conference on Genetic Algorithms, pp. 42-50, Morgan Kaufmann: San Mateo, CA.
- Deb, K., S. Agrawal, A. Pratap, and T. Meyarivan 2000 A Fast Elitist Non-Dominated Sorting Genetic Algorithm for Multi-objective Optimization: NSGA-II, Kanpur Genetic Algorithm Laboratory (KanGAL) Report 200001, Indian Institute of Technology, Kanpur, India.
- Deb, K. 2001 *Multi-Objective Optimization using Evolutionary Algorithms*, John Wiley & Sons LTD: New York, NY.
- Deb, K., L. Thiele, M. Laumanns, and E. Zitzler 2001 Scalable Test Problems for Evolutionary Multi-Objective Optimization, Computer Engineering and Networks Laboratory Report (TIK-112), Department of Electrical Engineering, Swiss Federal Institute of Technology, Zurich, Switzerland.
- DeJong, K. A. 1975 *An analysis of the behavior of a class of genetic adaptive systems*, Doctoral dissertation, University of Michigan: Ann Arbor, MI.

- Delfiner, P. 1976 Linear estimation of nonstationary spatial phenomena, in *Advanced Geostatistics in the Mining Industry*, (ed.) M. Guarascio, pp. 49-68, D. Reidel, Dordrecht, Holland.
- De Neufville, Richard 1990 *Applied Systems Analysis: Engineering Planning and Technology Management*, McGraw-Hill Publishing Company, New York, NY.
- Deutsch, Clayton V., and Andre G. Journel 1998 *GSLIB: Geostatistical Software Library and User's Guide*, Oxford University Press, New York, NY.
- DOE 2001 *Adaptive Sampling and Analysis Programs (ASAPs)*, Innovative Technology Summary Report, DOE/EM-0592, USDOE Office of Science and Technology.
- Fonseca, C. M. and P. J. Fleming 1995 An overview of evolutionary algorithms in multiobjective optimization. *Evolutionary Computation*, 3(1), 1-16.
- Gambolati, G. and G. Volpi 1979 A conceptual deterministic analysis of the kriging technique in hydrology, *Water Resources Research*, 15(3), 625-629.
- Goldberg, D. E. and J. Richardson 1987 Genetic algorithms with sharing for multimodal function optimization. In J. J. Grefenstette, ed. *Genetic Algorithms and Their Applications: Proceedings of the Second International Conference on Genetic Algorithms*, pp. 41-49, Morgan Kaufmann: San Mateo, CA.
- Goldberg, D. E. 1989 *Genetic Algorithms in Search, Optimization, and Machine Learning*, Addison-Wesley: New York, NY.
- Goldberg, D.E., K. Deb, and B. Korb 1989 Messy genetic algorithms: Motivation, analysis, and first results. *Complex Systems*, 3(4), 493-530.

- Goldberg, D. E., K. Deb, and J. H. Clark 1992a Genetic algorithms, noise, and the sizing of populations, *Complex Systems*, 6, 333-362.
- Goldberg, D. E., K. Deb, and J. Horn 1992b Massive multimodality, deception, and genetic algorithms. In R. Männer & B. Manderick, eds. *Parallel Problem Solving From Nature*, 2, Amsterdam: North-Holland.
- Goldberg, D. E. 1998 *The Race, the Hurdle, and the Sweet Spot: Lessons from Genetic Algorithms for the Automation of Design Innovation and Creativity*, Department of General Engineering, University of Illinois at Urbana-Champaign, ILLIGAL Report No. 98007.
- Goovaerts, Pierre 1997 *Geostatistics for Natural Resource Evaluation*, Oxford University Press, New York, NY.
- Gotway, Carol A., R. B. Ferguson, G. W. Hergert, and T. A. Peterson 1996 Comparison of Kriging and Inverse-Distance Methods for Mapping Soil Parameters, *Soil Sci. Soc. Am. J.*, 60, 1237-1247.
- Graham, Wendy and Dennis McLaughlin 1989 Stochastic analysis of nonstationary subsurface solute transport 1: Unconditional Moments, *Water Resources Research*, 25(2):215-232.
- Graham, Wendy and Dennis McLaughlin 1989 Stochastic analysis of nonstationary subsurface solute transport 2: Conditional Moments, *Water Resources Research*, 25(11): 2331-2355.
- Gray, H. L. and W. R. Schucany 1972 *The Generalized Jackknife Statistic*, STATISTICS: Textbooks and Monographs, Volume 1, Marcel Dekker, Inc., New York, NY.

- Gupta, H. V., S. Sorooshian, and P. O. Yapo 1998 Toward improved calibration of hydrologic models: Multiple and noncommensurable measures of information. *Water Resources Research*, 34(4), 751-763.
- Halhal, D., G. A. Walters, D. Ouazar, and D. A. Savic 1997 Water network rehabilitation with structured messy genetic algorithm. *Journal of Water Resources Planning and Management*, 123(3), 137-146.
- Haan, Charles T. 1977 *Statistical Methods in Hydrology*, The Iowa State University Press, Ames IA.
- Herrera de Olivares, G. 1998 *Cost Effective Groundwater Quality Sampling Network Design*, Doctoral dissertation, University of Vermont: Burlington, VT.
- Hogg, R. V. and E. A. Tanis 1997 *Probability and Statistical Inference*, 5th Ed., Prentice Hall, Upper Saddle River, NJ.
- Horn, J. 1997 *The Nature of Niching: Genetic Algorithms and the Evolution of Optimal, Cooperative Populations*, Doctoral dissertation, University of Illinois: Urbana, IL.
- Holland, J. H. 1975 *Adaptation in Natural and Artificial Systems*, University of Michigan: Ann Arbor, MI.
- Hsueh, Y. W., and R. Rajagopal 1988 Modeling ground-water quality decisions, *Ground-Water Monitoring Review*, 8(4), 121-134.
- Hudak, P. F., and H. A. Loaiciga 1992 A location modeling approach for groundwater monitoring network augmentation, *Water Resources Research*, 28(3), 643-649.
- Hudak, P.F., and H. A. Loaiciga 1993 An optimization method for monitoring network design in multilayered groundwater flow systems, *Water Resources Research*, 29(8), 2835-2845.

- Hughes, J. P. and D. P. Lettenmaier 1981 Data Requirements for Kriging: Estimation and Network Design, *Water Resources Research*, 17(6), 1641-1650.
- Ishibuchi, H. and T. Murata 1996 Multi-objective genetic local search algorithm. In Proceedings of 1996 IEEE International Conference on Evolutionary Computation, pp. 119-124, IEEE: Piscataway, NJ.
- James, Bruce, R., and Steven M. Gorelick 1994 When enough is enough: The worth of monitoring data in aquifer remediation design, *Water Resources Research*, 30(12), 3499-3513.
- Journal, A. G. 1983 Nonparametric estimation of spatial distributions, *Journal of the International Association for Mathematical Geology*, 15(3), 445-468.
- Journal, A. G. 1988 Nonparametric geostatistics for risk and additional sampling assessment, in L. H. Keith (ed.) Principles of Environmental Sampling, pp. 45-72, American Chemical Society.
- Journal, A. G. and C. V. Deutsch 1997 Rank Order Geostatistics: A proposal for a unique coding and common processing of diverse data, In E.Y. Baafi and N. A. Schofield (eds.) Geostatistics Wollongong '96, Volume 1, Proceedings of the 5th International Geostatistics Congress, Wollongong, Australia, Kluwer Academy Publ., Dordrecht, The Netherlands.
- Journal, A. G. and J. Huijbregts 1978 *Mining Geostatistics*, Academic Press, New York, NY.
- Journal, A. G. and M. E. Rossi 1989 When Do We Need a Trend Model in Kriging?, *Mathematical Geology*, 21(7), 715-739.

- Johnson, V. M., R. C. Tuckfield, M. N. Ridley, and R. A. Anderson 1996 Reducing the sampling frequency of groundwater monitoring wells, *Environmental Science & Technology*, 30(1), 355-358.
- Kai-Wei, Juang, Dar-Yuan Lee, and Timothy R. Ellsworth Delineation of Heavy Metal Contaminated Soils with Highly Skewed Data using Quantile Kriging, *Journal of Environmental Quality* (in press).
- Kitanidis, Peter K. 1983 Statistical estimation of polynomial generalized covariance functions and hydrologic applications, *Water Resources Research*, 19(4), 909-921.
- Kitanidis, Peter K. 1997 *Introduction to Geostatistics with Applications in Hydrogeology*, Cambridge University Press, New York, NY.
- Knopman, D. S. and C. I. Voss 1989 Multiobjective sampling design for parameter estimation and model discrimination in groundwater solute transport, *Water Resources Research*, 25(10): 2245-2258.
- Loaiciga, Hugo, A. 1989 An optimization approach for groundwater quality monitoring network design, *Water Resources Research*, 25(8), 1771-1780.
- Loaiciga, Hugo, A., R. J. Charbeneau, L. G. Everett, G. E. Fogg, B. F. Hobbs, S. Rouhani 1992 Review of Ground-Water Quality Monitoring Network Design, *Journal of Hydraulic Engineering*, 118(1), 11-37.
- Lobo, F., 2000 *The Parameter-less Genetic Algorithm: Rational and Automated Parameter Selection for Simplified Genetic Algorithm Operation*, Doctoral Dissertation, Universidade Nova de Lisboa, Lisboa, Portugal.

- Mahfoud, S. 1995 *Niching Methods for Genetic Algorithms*, Doctoral dissertation, University of Illinois: Urbana, IL.
- Marshall, R. and K. Mardia 1985 Minimum norm quadratic estimation of components of spatial covariance, *Journal of the International Association for Mathematical Geology*, 17(5), 517-525.
- Massmann, J., and R. A. Freeze 1987a Groundwater contamination from waste management sites: The interaction between risk-based engineering design and regulatory policy, 1, Methodology, *Water Resources Research*, 23(2), 351-367.
- Massmann, J., and R. A. Freeze 1987b Groundwater contamination from waste management sites: The interaction between risk-based engineering design and regulatory policy, 2, Results, *Water Resources Research*, 23(2), 368-380.
- Matheron, G. 1965 *Les variables régionalisées et leur estimation. Une application de la théorie des fonctions aléatoires aux Sciences de la Nature*, Masson, Paris.
- Matheron, G. 1971 *The theory of Regionalized Variables and Its Applications*, Ecole Des Mines, Fontainebleau, France.
- Matheron, G. 1969. *Le krigeage universel*, Cahiers du Centre de Morphologie Mathématique de Fontainebleau, Fasc. 1, Ecole des Mines de Paris.
- Matheron, G. 1973 The intrinsic random function and its application, *Advances in Applied Probability*, 5, 438-468.
- Maxwell, Reed M., Carle, Steven F., and Tompson, F. B. 2000 Contamination, Risk, and Heterogeneity: On the Effectiveness of Aquifer Remediation, Lawrence Livermore National Laboratory Report, UCRL-JC-139664, Livermore, CA.

- McAllister, P.M., and C. Y. Chiang 1994 A practical approach to evaluating natural attenuation of contaminants in ground water, *Ground Water Monitoring and Remediation*, 14(2), 161-173.
- Meyer, P. D., and E. D. Brill 1988 A method for locating wells in a groundwater monitoring under conditions of uncertainty, *Water Resources Research*, 24(8), 1277-1282.
- Meyer, P.D., Albert J. Valocchi, and J. Wayland Eheart 1994 Monitoring network design to provide initial detection of groundwater contamination, *Water Resources Research*, 30(9), 2647-2659.
- Michael, W. J., D. K. Tcheng, B. S. Minsker, A. J. Valocchi, J. J. Quinn, and G. P. Williams 2002 Integrating Data Sources to Optimize Long-Term Monitoring, Operation, and Stewardship, The 3rd International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Monterey, CA, in press.
- Montas, H. J., R. H. Mohtar, A. E. Hassan, F. A. AlKhal 2000, Heuristic space—time design of monitoring wells for contaminant plume characterization in stochastic flow fields, *Journal of Contaminant Hydrology*, 43, 271-301.
- Moré, J. J. 1977 The Levenberg-Marquardt algorithm: Implementation and theory. In G. A. Watson, ed. *Numerical Analysis*, pp. 105-116, Springer-Verlag: New York.
- National Research Council 1993 *In Situ Bioremediation: When Does It Work?*, National Academy Press, Washington, D.C.
- National Research Council 1997 *Innovations in Ground Water and Soil Cleanup: From Concept to Commercialization*, National Academy Press, Washington, D.C.

- National Research Council 1999 *Environmental Cleanup at Navy Facilities: Risk-Based Methods*, National Academy Press, Washington, D.C.
- Nyer, Evan, Polly Mayfield, and Joseph Hughes 1998 Beyond the AFCEE Protocol for Natural Attenuation, *Ground Water Monitoring and Remediation*, 18(3), 70–77.
- Olea, R. A. 1984 Sampling design optimization for spatial functions, *Mathematical Geology*, 16(4), 365-391.
- Parks, G. T. and I. Miller 1998 Selective breeding in a multiobjective genetic algorithm. In A. E. Eiben, T. Bäck, M. Schoenauer, and H. Schwefel, eds. Fifth International Conference on Parallel Problem Solving from Nature, pp. 250-259, Springer: Berlin, Germany.
- Rast, R. ed. 1997 *Environmental Restoration: Unit Cost Book*, R. S. Means: Kingston MA.
- Reed, P., B. Minsker, and A. J. Valocchi 2000a Cost effective long-term groundwater monitoring design using a genetic algorithm and global mass interpolation. *Water Resources Research*, 36(12): 3731-3741.
- Reed, P., B. Minsker, and D. E. Goldberg, 2000b Designing a competent simple genetic algorithm for search and optimization. *Water Resources Research*, 36(12): 3757-3761.
- Reed, P., B. Minsker , and D. E. Goldberg 2001a A multiobjective approach to cost effective long-term groundwater monitoring using an Elitist Nondominated Sorted Genetic Algorithm with historical data, *Journal of Hydroinformatics*, 3(2), 71-90.
- Reed, P., B. S. Minsker, and A. Valocchi, 2001b Why Optimize Long Term Groundwater Monitoring Design? A Multiobjective Case Study of Hill Air Force Base, "Bridging the Gap: Meeting the World's Water and Environmental Resources Challenges", Proceedings of the World Water and Environmental Resources Congress (ISBN 0-7844-0569-7),

- Orlando, FL, ed. Don Phelps and Gerald Sehlke, American Society of Civil Engineers, Washington, DC.
- Reed, P., T. R. Ellsworth, and B. Minsker, 2002 Spatial Interpolation Methods for Nonstationary Plume Data, *Ground Water*, In Review.
- Ritzel, B. J., Eheart, J. E., & Ranjithan, S. 1994 Using genetic algorithms to solve a multiple objective groundwater pollution containment problem. *Water Resources Research*, 30(5), 1589-1603.
- Rizzo, D. M., D. E. Dougherty, and M. Yu 2000 An adaptive long-term monitoring and operations system (aLTMOs) for optimization in environmental management, In ASCE 2000 Joint Conference on Water Resources Engineering and Water Resources Planning and Management, Minneapolis, MN.
- Rouhani, S. 1985 Variance reduction analysis, *Water Resources Research*, 21(6), 837-846.
- Rouhani, S., and T. J. Hall 1988 Geostatistical schemes for groundwater sampling, *Journal of Hydrology*, 103, 85-102.
- Russo, D. 1984 Design of an optimal sampling network for estimating the variogram, *Soil Sci. Soc. Am. J.*, 45, 682-687.
- Russo, D. and W. A. Jury 1987 A theoretical study of the estimation of the correlation scale in spatially variable fields 2: Nonstationary Fields, *Water Resources Research*, 23(7), 1269-1279.
- Russo, D. and W. A. Jury 1988 Effect of the sampling network on estimates of the covariance function of stationary fields, *Soil Sci. Soc. Am. J.*, 52, 1228-1234.

- Storck, Pascal, J. Wayland Eheart, and Albert J. Valocchi 1997 A method for the optimal location of monitoring wells for detection of groundwater contamination in three-dimensional aquifers, *Water Resources Research*, 33(9), 2081-2088.
- Schaffer, J. D. 1984 *Some experiments in machine learning using vector evaluated genetic algorithms*, Doctoral dissertation, Vanderbilt University: Nashville, TN.
- Schaffer, J. D., R. A. Caruana, L. J. Eshelman, and R. Das 1989 A study of control parameters affecting online performance of genetic algorithms for function optimization, In Schaffer, J. D. (Ed.), *Proceedings of the Third International Conference on Genetic Algorithms*, p. 51-60, Morgan Kaufmann, San Mateo, CA.
- Smalley, J., B. Minsker, and D. E. Goldberg 2000 Risk-based in situ bioremediation design using a noisy genetic algorithm, *Water Resources Research*, 36(10), 3043-3052.
- Srinivas, N. and K. Deb 1995 Multiobjective optimization using nondominated sorting in genetic algorithms, *Evolutionary Computation*, 2(3), 221-248.
- Thierens, D. and D. E. Goldberg 1993 Mixing in genetic algorithms. In S. Forrest, ed. *Proceedings of the Fifth International Conference on Genetic Algorithms*, pp. 38-45, Morgan Kaufmann Publishers: San Mateo, CA.
- Thierens, D. and D. E. Goldberg 1994 Convergence Models of Genetic Algorithm Selection Schemes, In Y. Davidor, Hans-Paul Schwefel, and Reinhard Manner, eds. *Proceedings of the Third Conference on Parallel Problem Solving from Nature*, pp. 119-129, Springer-Verlag: New York, NY.
- Thierens, D. 1995 *Analysis and design of genetic algorithms*, Doctoral dissertation, Katholieke Universiteit Leuven, Leuven, Belgium.

- Thierens, D., D. E. Goldberg, and A. G. Pereira 1998 Domino Convergence, Drift, and the Temporal-Salience Structure of Problems, In The 1998 IEEE International Conference on Evolutionary Computation Proceedings, pp. 535-540, IEEE Press: New York, NY.
- Van Veldhuizen, D. A. 1999 Multiobjective Evolutionary Algorithms: Classifications, Analyses, and New Innovations, Doctoral dissertation, AFIT/DS/ENG/99-01, Air Force Institute of Technology: Wright-Patterson AFB, Ohio.
- Van Veldhuizen, D. A. and G. B. Lamont 2000 Multiobjective evolutionary algorithms: analyzing the state-of-the-art. *Evolutionary Computation*, 8(2), 125-147.
- Volpi, G. and G. Gambolati 1978 On the use of a main trend for the kriging technique in hydrology, *Advances in Water Resources*, 1, 345-349.
- Wagner, Brian J. 1995 Sampling design methods for groundwater modeling under uncertainty, *Water Resources Research*, 31(10):2581-2591.
- Warrick, A. and D. E. Myers 1987 Optimization of sampling locations for variogram calculations, *Water Resources Research*, 23(3): 496-500.
- Yfantis, E. A., G. T. Flatman, and J. V. Behar 1987 Efficiency of kriging estimation for square, triangular, and hexagonal grids, *Mathematical Geology*, 19(3), 183-205.
- Zitzler, E. and L. Thiele 1999 Multiobjective evolutionary algorithms: a comparative case study and the strength Pareto approach. *IEEE Transactions on Evolutionary Computation*, 3(4), 257-271.
- Zitzler, E., K. Deb, and L. Thiele 2000 Comparison of multiobjective evolutionary algorithms: empirical results. *Evolutionary Computation*, 8(2), 173-195.

Zitzler, E., M. Laumanns, and L. Thiele 2001 SPEA2: Improving the Strength Pareto Evolutionary Algorithm, Computer Engineering and Networks Laboratory Report (TIK-103), Department of Electrical Engineering, Swiss Federal Institute of Technology, Zurich, Switzerland.

REFERENCES.....155