SEMINARIO: Tópicos de Optimización no Lineal

Profesor responsable: Maria Cristina Maciel.

Requisitos: Este seminario está dirigido a los alumnos graduados de Matemática y áreas relacionadas. Los mismos deben tener sólidos conocimientos de Análisis Numérico, en particular de:

1. Análisis Numérico,
2. Optimización y Optimización Numérica

Objetivo: En este seminario se estudiarán y discutirán nuevas técnicas para resolver problemas de optimización no lineal, incluyendo optimización multiobjetivo, optimización bilevel y aplicaciones.
Se presentarán artículos recientemente públicados. Dicha presentación incluirá: justificación matemática, implementación, ventajas y desventajas con respecto a técnicas ya existentes.

Programa

1. Programación no lineal sin función de mérito

1. Revisión de funciones de mérito en problemas de programación no lineal.
2. Concepto de filtro.
3. Métodos básados en de búsqueda lineal.
4. Métodos básados en de región de confianza.
5. Métodos no monótonos. Análisis de convergencia.

bibliografía: [11, 12, 11, 13, 14, 16, 28, 27, 15, 17]

2. Optimización en espacios matriciales

1. Ecuación algebraica de Riccati. Matriz signo.
2. Método de Newton para resolver la equación de Riccati.
3. Método de Newton para la resolución del problema de programación cuadrática.

bibliografía: [6, 9, 18, 19, 20, 10]

3. Condiciones calificadoras en programación no lineal

1. Condiciones de optimalidad de Karush-Kuhn-Tucker.
2. Condiciones de optimalidad de Fritz-John. Regularidad.

3. Condiciones calificadoras de Mangasarian-Fromovitz.
4. Cuasiregularidad, cuasinormalidad. Existencia de los multiplicadores de Lagrange.
5. Condición de dependencia lineal positiva constante (CPLD).

   bibliografía: [2, 25, 26, 1]

4. Optimización multiobjetivo

1. Fundamentos de optimización multiobjetivo. Punto y frontera pareto
2. Condiciones de optimalidad para el caso diferenciable.
3. Condiciones calificadoras y condiciones de regularidad.

   bibliografía: [21, 24, 25, 26, 1]

5. Optimización bilevel

1. Fundamentos de optimización bilevel.
2. Problemas de equilibrio químico.
3. Algoritmos.

   bibliografía: [7, 8, 3, 4, 5, 22, 23]

Referencias

[1] R. ANDREANI, J.M. MARTINEZ, and M.L. SCHUVERDT. On the relation between the constant positive linear dependence condition and quasinormality constraint qualification. *Journal of Optimization Theory and Aplications*, 125:473– 485, 2005.

[2] D.P. BERTSEKAS. *Nonlinear Programming.* Athenas Scientific, Belmont, MA, 1999. Second Edition.

[3] J. BRACKEN and J. McGILL. Mathematical programs with optimization problems in the constraints. *Operations Research*, 21:37–44, 1973.

[4] J. BRACKEN and J. McGILL. Defense of applications of mathematical programs with optimization problems in the constraints. *Operations Research*, 22:1086–1096, 1974.

[5] J. BRACKEN and J. McGILL. Production and marketing decision with mutiple objetives in a competitive environment. *Journal of Optimization Theory and Aplications*, 24:449–458, 1978.

[6] K-W.E. CHU. The solution of the matrix equations $AXB - CXD = E$ and $YA - DZ, YC - BZ) = (E, F)$. *Linear Algebra and its Applications*, 93:93–105, 1987.

[7] B. COLSON, P. MARCOTTE, and G. SAVARD. Bilevel programming: A survey. *A quarterly Journal of Operations Research*, 3(2):87–107, 2005.

[8] S. DEMPE. *Foundations of Bilevel Programming.* Kuwer Academic Publishers, Netherlands, 2002.

[9] E.D. DENMAN. Roots of real matrices. *Linear Algebra and its Applications*, 36:133–139, 1981.

[10] M.G. EBERLE and M.C. MACIEL. Finding the closest Toeplitz matrix. *Computational and Applied Mathematics*, 22(1):1–18, 2003.

[11] R. FLETCHER, N.I.M. GOULD, S. LEYFFER, and Ph.L. TOINT. Global convergence of trust-region sqp- filter algorithms for general nonlinear programming. Technical Report RAL-TR-1999-041, Comput. Sci. and Engrg. Department, Rutherford Appleton Laboratory, Oxfordshire,OX110QX,UK, 1999.

[12] R. FLETCHER and S. LEYFFER. Nonlinear programming without a penalty function. Technical Report NA/171, Department of Mathematic, University of Dundee, Dundee, DD1,4HN, Schotland, UK, 1998.

[13] R. FLETCHER and S. LEYFFER. Numerical experience with solving MPECs as NLPs. Technical Report NA/210, Department of Mathematic, University of Dundee, Dundee, DD1,4HN, Schotland, UK, 2002.

[14] R. FLETCHER, S. LEYFFER, and Ph.L. TOINT. On the global convergence of a SLP-filter algorithm. Technical Report NA/183, Department of Mathematic, University of Dundee, Dundee, DD1,4HN, Schotland, UK, 1999.

[15] F.M.A. GOMES. A sequential programming algorithm that combines merit function and filter ideas. Technical report, IMMECC-UNICAM, Campinas,SP, Brazil, 2005.

[16] C. GONZAGA, E. KARAS, and M. VANTI. A globally convergent filter method for nonlinear programming. Technical report, Department of Mathematics, Federal University of Santa Catarina, Florianopolis, SC, Brazil, 2002.

[17] L. GRIPPO, F. LAMPARIELLO, and S. LUCIDI. A nonmonotone line search technique for Newton's method. *Siam Journal on Numerical Analysis*, 23(4):707–716, 1986.

[18] N.J. HIGHAM. Newton's method for the matrix square root. *Mathematics of Computation*, 46(174):537–549, 1986.

[19] N.J. HIGHAM and H-M. KIM. Solving a quadratic matrix equation by Newton method with exact line searchs. Technical report, Department of Mathematics, University of Manchester, Manchester, England, 1999.

[20] N.J. HIGHAM and H-M. KIM. Numerical analysis on a quadratic matrix equation. *IMA Journal of Numerical Analysis*, 23:1–22, 2000.

[21] T. MAEDA. Constraint qualifications un multiobjective optimization problemas: differentiable case. *Journal of Optimization Theory and Aplications*, 80(3):483– 500, 1994.

[22] J.M. MARTINEZ and E.A.PILOTTA. Inexact-restoration algorithm for constrained optimization. *Journal of Optimization Theory and Applications*, 104:135–163, 2000.

[23] J.M. MARTINEZ and E.A. PILOTTA. Inexact restoration methods for nonlinear programming: Advances and perspectives. In L. Q. Qi, K. L. Teo, and X. Q. Yang, editors, *Optimization and Control with Applications*, pages 271–292. Springer, 2005.

[24] K.M. MIETTINEN. *Nnonlinear Multiobjetive Optimization.* Kuwer Academic Publishers, Netherlands, 2002.

[25] L. QI and Z. WEI. On the constant positive linear dependence condition and its application to SQP problems. *Siam Journal on Optimization*, 10:963–981, 2000.

[26] M.L. SCHUVERDT. *Métodos de langragiano aumentado com convergencia utilizandoa condição de dependencia linear positiva constante.* PhD thesis, Department of Applied Mathematics, IMECC-UNICAMO, University of Campinas, Campinas, Sâo Paulo, 2005.

[27] M. ULBRICH and S. ULBRICH. Nonmonotone trust region methods foe nonlinear equality constrained optimization without a penalty function. Technical report, Zentrum Mathematik, Technische Universität München, München, Germany, 2000.

[28] A. WÄCHTER and L.T. BIEGLER. Global and local convergence of line search filter method for nonlinear programming. Technical Report CAPD TR B-01-09, Dept. of Chemical Engrg., Carnegie Mellon University, Pittsburgh, PA 15213, 2002.