

國立臺北大學自然資源與環境管理研究所
103 學年度第二學期 『環境系統分析專題』

課程講義(14)：非線性規劃與演算法

Nonlinear Programming and Algorithm

Nonlinear Programming: Concepts, Algorithms and Applications

(<http://cepac.cheme.cmu.edu/pasilectures/biegler/BieglerLecture.pdf>)

Global Optimization Algorithms - Theory and Application (<http://www.it-weise.de/projects/book.pdf>)

Nonlinear Programming (Chapter 13) in *Applied Mathematical Programming*

(<http://web.mit.edu/15.053/www/AMP-Chapter-13.pdf>)

● NONLINEAR PROGRAMMING -- INTRODUCTION

- Formulations of the Models and Complexity
- Local Optima vs. Global Optima
- Convexity and Convex Programming
 - ⇒ Convexity of a Function: Convex, Concave and Un-determinant
 - ⇒ Convex Region vs. Non-convex Region
- Analytical Solutions vs. Numerical Solutions
 - ⇒ Linearization of Nonlinear Objective Function => May not be necessary nowadays!
 - ⇒ Software Packages => Lingo, What'sBest, GAMS (NLP) etc.

● UNCONSTRAINED OPTIMIZATION

- Minima, Maxima and Saddle Points
 - ⇒ Necessary Conditions and Sufficient Conditions
- Gradient of a Function (First Derivatives)
- Hessian Matrix (Second Derivatives)
 - ⇒ Positively Definite: All the Eigenvalues are Positive

● LAGRANGE MULTIPLIERS AND OTHER METHODS

- Lagrange Multiplier Method
 - ⇒ Constraints with All Equalities
 - ⇒ Properties of the Lagrange Multipliers
- Kuhn-Tucker Conditions: Constraints with Inequalities
- Gradient Search Procedure (Greedy) => Danger of Being Trapped at Local Optima

● ALGORITHMS FOR NONLINEAR PROGRAMS

- Numerical Methods (Chang, 2002, Chap.5)
 - ⇒ Newton Method, Conjugative Direction and Conjugative Gradient Methods
- Top-Ten Algorithms
- Heuristic Algorithms => Soft Computation => Emulation of Natural Phenomena
 - ⇒ Artificial Neural Network; Genetic Algorithms
 - ⇒ Simulated Annealing; Tabu Search
 - ⇒ Ant Search, Ant Colony Algorithm, Swarm Intelligence, etc.