Master thesis of *Jeng-Han Chang*

Solving the network flow problem by a least-squares primal-dual method

Jeng-Han Chang

Department of Industrial and Information Management

National Cheng Kung University

The network flow problem is a specialized Linear Programming problem (LP) due to its special constraint structure. An LP solution method may have a more efficient implementation when applied for solving the network flow problem. Recently, a new primal-dual algorithm called the least-squares primal-dual (LSPD) method has been proposed to solve LPs with good performance since it guarantees nondegenerate pivoting in each iteration. In each primal-dual iteration, the LSPD algorithm solves a nonnegative least squares (NNLS) subproblem to obtain an improving direction for its dual variables.

In this thesis, we develop techniques related with the LSPD method for solving network flow problems. Issues regarding efficient ways to obtain an initial dual feasible solution and techniques to deal with capacitated network flow problems will be investigated. We also propose a new least-squares dual-primal (LSDP) algorithm which differs from the LSPD algorithm in exchanging the roles of the primal and dual formulations. When solving for the max-flow problem, the NNLS subproblem in our LSDP algorithm can be treated as an algorithm to calculate the current on an electrical network with diodes, where the unit-flow cost associated with an arc can be treated the electrical potential. Thus the Kirchhoff's law can be applied to solve the NNLS subproblem. Similar techniques can be applied to solve the MCF problem.

***Keywords*:** network optimization, minimum cost flow problem, primal-dual algorithm, nonnegative least-squares, degeneracy, maximum flow problem

Thesis advisor: *I-Lin Wang*, ilinwang@mail.ncku.edu.tw
http://ilin.iim.ncku.edu.tw
***Jeng-Han Chang* entered IIM of NCKU in 2004, graduated in 2006.**