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# Summary of I-Lin Wang's Research Works

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# Outline

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- Biography
- Journal Publications
- Publication & Awards Summary
- Projects
- Research Interests
- Detailed Research Topics

# Biography

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- Undergraduate (87~91) : Aerospace engineering, NCKU
  - Orbital mechanics
- Master (94~96) : Operations Research Center, MIT
  - Premultiplier network simplex algorithm under Prof. Orlin
- Researcher (96~97) : Network system lab, Fujitsu, JP
  - Optical network wavelength routing & assignment algorithm
- Ph.D. (98~03) : ISyE, GA Tech
  - Shortest paths and multicommodity flows under Prof. Johnson
- Assistant professor (03~07) : IIM, NCKU
- Associate professor (07~) : IIM, NCKU

# Publications (1/3)

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## □ Journal papers

- Wang, I.-L., E.L. Johnson, J.S. Sokol, 2005, [A multiple pairs shortest path algorithm](#), *Transportation Science*, 39(4), pp. 465-476. (SCI/SSCI)
- Sheu, R.L., M.J. Ting, I.-L. Wang, 2006, [Maximum flow problem in the distribution network](#), *Journal of Industrial and Management Optimization*, 2(3), pp. 237-254. (SCI)
- Wang, I.-L., W.-C. Yang, 2007, [Fast Heuristics for Designing Integrated E-Waste Reverse Logistics Networks](#), *IEEE Transactions on Electronics Packaging Manufacturing*, 30(2), pp. 147-154. (SCI)
- Wang, I.-L., 2008, [Distribution of Small Packages in Metropolitan Area by Motorcycle Courier Services](#), *International Journal of Integrated Supply Management*, 4(1), pp. 88-101.
- Wang, I.-L., 2008, [On solving shortest paths with a least-squares primal-dual algorithm](#), *Asia-Pacific Journal of Operational Research*, 25(2), pp. 135-150. (SCI)
- Wang, I.-L., Y.-H. Yang, 2009, [On Solving the Uncapacitated Minimum Cost Flow Problems in a Distribution Network](#), *International Journal of Reliability and Quality Performance*, 1(1), pp. 53-63.
- Wang, I.-L., S.-J. Lin, 2009, [A network simplex algorithm for solving the minimum distribution cost problem](#), *Journal of Industrial and Management Optimization*, 5(4), pp. 929-950. (SCI)

# Publications (2/3)

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## □ Journal papers

- Wang, I.-L., Y.-C. Tsai, F. Li, 2011, [A Network Flow Model for Clustering Pavement Segments with Minimum Total Costs](#), *Computers & Industrial Engineering*, 60(4), pp. 593-601. (SCI)
- Wang, I.-L., C.-Y. Chang, 2011, [Mathematical properties and an integer programming model on haplotyping populations by pure parsimony](#), *Mathematical Biosciences*, 231(2), pp.120-125. (SCI)
- Wang, I.-L., H.-E. Yang, 2011 Apr, [Haplotyping populations by pure parsimony based on compatible genotypes and greedy heuristics](#), *Applied Mathematics and Computation*, 217(23), pp. 9798-9809 (SCI)
- Wang, I.-L., T.H. Yang, Y.-B. Chang, 2012, [Scheduling two-stage hybrid flow shops with parallel batch, release time, and machine eligibility constraints](#), *Journal of Intelligent Manufacturing*, 23(6), pp.2271-2280 (SCI)
- Wang, I.-L., Y.-C. Wang, C.-W. Chen, 2013, [Scheduling unrelated parallel machines in semiconductor manufacturing by problem reduction and local search heuristics](#), *Flexible Services and Manufacturing*, 25(3), pp.343-366 (SCI)

# Publications (3/3)

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## □ Journal papers (by 2013.09.29)

- Shu, J., M.C. Chou, Q. Liu, C.-P. Teo, I.-L. Wang, 2013, [Models for Effective Deployment and Redistribution of Bicycles within Public Bicycle-Sharing Systems](#), *Operations Research*, (accepted in Aug. 2013) (SCI/SSCI)

# Publications & Awards Summary

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- **Summary of publications** (by 2013.09.29)
  - Int. Journal: 11 (SCI/SSCI: 11; non-SCI: 2)
  - Int. Conference (outside TW): 13
  - Int. Conference (inside TW): 23
  - Dom. Conference: 26
- **Awards Received** (by 2013.09.29; from 26 master students; 4 undergraduate groups)
  - INFORMS RAS Problem Solving Competition Award
    - 1 finalist (top 3@2011); 2 honorable mention (top 4@2010,2013);
  - Master Thesis / Best Paper Awards (served as thesis advisor / co-author)
    - 22 awards (8 1st place; 2 2nd place; 1 3<sup>rd</sup> place; 1 fourth place; 10 best papers)
      - By ORSTW: 9; CIIE: 9; CIT: 1; DHL: 1; Automation: 1; ICLS: 1
  - Undergraduate Projects Awards (served as thesis advisor / coauthor)
    - 4 awards (2 first place; 1 second place; 1 best papers)
  - NSC Awards
    - 1 poster award; 1 Grantee of Research Project for Outstanding Young Researcher (by NSC IE Division)

# Projects (1/4)

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## □ NSC Research Projects

- Multiple Pairs Shortest Paths Algorithms  
NTD 362,800 NSC 92-2213-E-006-094
- New column generation and partitioning methods for multicommodity network flow problems  
NTD 509,900 NSC 93-2213-E-006-096
- New nonnegative least squares primal-dual methods for network optimization problems  
NTD 150,000 NCKU 950104
- On solving the minimum distribution cost flow and maximum distribution flow problems  
NTD 651,000 NSC 95-2221-E-006-268
- Haplotyping population by optimization theorems and algorithms (I)  
NTD 590,000 NSC 96-2221-E-006-015
- Haplotyping population by optimization theorems and algorithms (II)  
NTD 585,000 NSC 97-2221-E-006-173



# Projects (2/4)

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- A Study on Reliability for Distribution Networks with Multi-state Capacitated Arcs  
NTD 1,279,000 NSC 98-2410-H-006-115-MY2
- A Study on the Network Design and Bike Repositioning for Urban Bike Sharing Systems  
NTD 984,000 NSC 100-2410-H-006-006-MY2
- Design and Repositioning Strategies for the Public Bike and E-scooter Sharing Systems (*Outstanding Young Researcher Grant*)  
NTD 2,124,000 NSC 102-2221-E-006-141-MY3

# Projects (3/4)

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## □ NSC Undergraduate Student Projects (大專生專題計畫)

- Design of a Trip Planning Decision Support System for Public Transportation in a Metropolitan Area  
NTD 47,000 NSC 96-2815-C-006-065-H
- Computational Experiments by a Dual-Primal Non-negative Least Squares Method for Maximum Flow Problems  
NTD 47,000 NSC 97-2815-C-006-031-E
- Planning Optimal Bike Routes based on Target Calories Burned  
NTD 47,000 NSC 98-2815-C-006-107-H
- Solving the tagSNP Selection Problem by Bi-objective Programming  
NTD 47,000 NSC 98-2815-C-006-048-E
- A Simulation Study on the Management of Public E-scooter Sharing Systems for Commuters  
NTD 47,000 NSC 101-2815-C-006-063-E

# Projects (4/4)

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## □ Industry Project

- 300mm 晶圓廠即時性生產排程系統導入計畫 (TSMC)  
NTD 500,000
- 臺南市觀光自行車系統設置規劃案  
NTD 450,000

# Research Interests (1/3)

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## □ Network Optimization

- Shortest Path
- Maximum Flows
- Min-cost Flows
- Multicommodity Network Flows
- Distribution Networks (D-node)

## □ Logistics, Supply Chain Management

- Reverse Logistics Network Design
- Metropolitan Motorcycle Courier Systems
- Public Bicycle Sharing Systems

## □ Bioinformatics

- Haplotype Inference
- TagSNP Selection

# Research Interests (2/3)

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## □ Personal Navigation

- Quickest Itinerary Planning with/without Timetable
- Minimum Fare Itinerary Planning without Timetable
- Optimal Biking Routes with a Target Range of Calorie Consumption
- Optimal Euler Subgraphs of bounded lengths

## □ Network Reliability

- Reliability for Multi-state Capacitated Manufacturing Networks with Distillation Process

## □ Semiconductor Manufacturing

- 1-stage Complex Job-Shop Scheduling with recipe, release time, due date, and setup time consideration
- 2-stage Complex Job-Shop Scheduling with recipe, release time, due date, and batch process (2 jobs of the same recipe) consideration

## □ Data Mining

- Change Mining

# Research Interests (3/3)

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## □ Project Management

- Stable project baseline schedules with time constraints

## □ Staff Rostering

- Designing a Nurse Rostering Information System for Site Management Organizations
- Railway Staff Rostering and Re-rostering Problem

## □ Pavement Optimization

- Project level
- Network level

## □ Telecommunication

- Optimal wavelength assignment & routing algorithm
- Sensor Network

# Network Optimization (1/2)

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## □ Shortest Path:

- Multiple Pairs Shortest Path (MPSP) algorithms,  $O(n^3)$ , [paper](#)
- Primal-Dual Nonnegative Least Squares algorithm (PDNNLS) == Dijkstra's method, for nonnegative arc lengths, [paper](#)
- All Pairs Shortest Path (APSP) algorithm,  $O(n^3)$ ,
- Computational Experiments on MPSP algorithms,

## □ Maximum Flows:

- DPNNLS algorithm, solve the max-flow by Kirchhoff's laws,  $O(m^5n)$ ,
- Augment flows proportionally,  $O(mn^2)$ ,

# Network Optimization (2/2)

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## □ **Min-cost flows:**

- premultiplier network simplex algorithm (my [master thesis](#) )

## □ **Multicommodity Network Flows:** (my [ph.d. thesis](#))

- comprehensive survey
- primal-dual column generation method

## □ **Minimum Distribution Cost Problem:** (Distillation, D-node)

- shortest path, UMDCP1, UMDCP2, UMDCP3 , [paper](#)
- max-flow & generator
- min-cost network simplex method, detailed graphical operations, [paper](#)



# Logistics, Supply Chain Management (1/2)

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## □ Reverse Logistics Network Design

- facility location with different configurations; greedy heuristics, [paper](#)

## □ Metropolitan Motorcycle Courier Systems

- Monopoly performance estimation, [paper](#)
- Cournot game, 2 competitors, 4 scenarios (HS, PP)
- determine the most profitable HQ/LQ service percentages
- \*new network models without hub

## □ **Public Bicycle Sharing Systems**

- site location selection
- bike transshipment management to satisfy demand
- bike transshipment management considering advertisement exposure
- persistency model in site location (a QIP)
- dynamic bike repositioning based on proportional demands
- simulations for evaluating info sharing
- temporary manpower allocation vs. self bike repositioning
- simulation optimization on several important decisions
- E-scooter sharing systems

# Bioinformatics

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## □ Haplotype Inference

- compatible relation, merged genotype pairs (MGP)
- greedy selection with Clark's rule

## □ TagSNP Selection

- bi-objective mathematical programming to select tagSNPs with larger LD values
- Lagrangian Relaxation heuristics
- IP model to select robust tagSNPs for capacitated bio-chips

# Personal Navigation Systems

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- **Quickest Itinerary Planning without Timetable**
  - modeled as a constrained shortest path problem, given max # transfers
  - LR, KSP, preprocessing
- **Quickest Itinerary Planning with Timetable**
  - without transfer upper bounds, with/without Walk
  - shortest path on an acyclic graph, topological ordering algorithm with BFS/DFS speed-up techniques
- **Minimum Fare Itinerary Planning without Timetable**
  - shortest path on a complete graph, Dijkstra's algorithm with BFS/DFS speed-up techniques
  - models for special cases such as one free transfer after MRT, or "2-stage" bus routing in a single trip
- **Optimal Biking Routes with a Target Range of Calorie Consumption**
- **Optimal Euler Subgraphs of bounded lengths**

# Network Reliability

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- **Reliability for Multi-state Capacitated Manufacturing Networks with Distillation Process**
  - a compaction preprocessing scheme
  - algorithms to calculate the reliability (difficulty: fractional flow, flow dependency)
  - min-cost network design with given reliability lower bound
- **\*Approximation algorithm for calculating reliability**

# Semiconductor Manufacturing

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- **1-stage Complex Job-Shop Scheduling with recipe, release time, due date, and setup time consideration**
  - MIP formulation, problem decomposition (into single stages)
  - greedy dispatching rule (load balance), heuristics to reduce the number of variables
  - heuristics that involves more scheduling rather than dispatching
- **2-stage Complex Job-Shop Scheduling with recipe, release time, due date, and batch process (2 jobs of the same recipe) consideration**
  - MIP formulation, problem decomposition (into single stages)
  - greedy dispatching rule (FIFO)
  - heuristics that involves more scheduling rather than dispatching

# Data Mining

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## □ Change Mining

- given possible interruption duration with probability distribution, time-window

# Project Management

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- **stable project baseline schedules with time constraints**
  - given possible interruption duration with probability distribution, time-window & time-schedule constraints, 2 greedy heuristics & GA
  - project network generator



# Staff Rostering

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- **Designing a Nurse Rostering Information System for Site Management Organizations**
  - MIP formulation, greedy heuristics
  - an information system to verify schedules
- **Railway Staff Rostering and Re-rostering Problem**
  - MIP formulation, greedy heuristics

# Pavement Optimization

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- **With Prof. Tsai in Civil Eng., GA Tech**
- **Project level** (detailed work plan: which treatment, when, where)
  - segment clustering, give a network model, solved by topological ordering algorithm
  - with reliability idea, how to make a work plan such that the road condition meets the quality requirement with min-total-cost (also integrating the network level Markovian idea)
  - budget balance between working districts and political districts
- **Network level**
  - MIP formulation, how to allocate budget

# E-learning

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## □ **Grouping for better cooperative learning**

- MIP formulation that groups students for cooperative learning
- considering mutual compensation based on conceptual graph and other criteria



# Telecommunication

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- **Optimal wavelength assignment & routing algorithm**
- **Sensor Network**
  - sensor network localization problem



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# Thank you !

## Q & A

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