

**Binay Bhattacharya**  
School of Computing Science  
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## **Educational Background**

1982 Ph.D.	Computer Science, McGill University, Canada "Application of computational geometry to pattern recognition problems"
1978 M.Sc.	Computer Science, McGill University, Canada "Some numerical computations in linear estimation"
1969 M.Sc.	Pure Mathematics, University of Calcutta, India
1967 B.Sc.	University of Calcutta, India

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## **Employment History at Academic Institutions**

September 1992 - Current	Professor, Computer Science, Simon Fraser University
September 1987 - August 1992	Associate Professor, Computing Science, Simon Fraser University
January 1982 - August 1987	Assistant Professor, Computing Science, Simon Fraser University
September 1980 - December 1981	Lecturer, Computer Science, McGill University
December 1970 - December 1975	Research Assistant, Hydrometeorology, Indian Institute of Tropical Meteorology, India

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## **Current Research Interests**

One of the most important aspects of logistics is deciding where to locate new facilities such as retailers, warehouses or factories. For systems in which deliveries are made along multiple stop routes, the routing problem and the location problem must be considered simultaneously. These strategic decisions are a crucial determinant of whether materials will flow efficiently through the distribution system. Facility location analysis has played a central role in the development of operations research. Location problems encompass a wide range of problems such as the location of emergency services, location of hazardous materials, location of ATM bank machines, problems in telecommunication networks design, etc., just to name a few. My objective is to develop new tools to aid in the location of logistics to optimally serve the demands of customers. My approach is to study the applicability and the extendability of the most advanced theory and techniques, extend the existing techniques, and develop new paradigms to further the state of the art in the area of facility location optimization. [design and analysis of algorithms, computational geometry, resource allocation optimization, vehicle routing, scheduling, real-time, approximation algorithms]

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## Completed Works

### Journal Articles

Binay K. Bhattacharya, Qiaosheng Shi, Improved algorithms to network p-center location problems, *Computational Geometry*, 47(2): 307-315 (2014).

A. Karmakar, S. Das, S. C. Nandy, B. Bhattacharya, Some Variations on Constrained Minimum Enclosing Circle Problem, *Journal of Combinatorial Optimization*, 25(2): 176-190 (2013).

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Rong Ge, Martin Ester, Byron J. Gao, Zengjian Hu, Binay K. Bhattacharya, Boaz Ben-Moshe: Joint cluster analysis of attribute data and relationship data: The connected k-center problem, algorithms and applications. *TKDD* 2(2), 2008.

Mukhopadhyay, A., Kumar, C., Greene, E., Bhattacharya, B.K., On intersecting a set of parallel line segments with a convex polygon of minimum area, *Information Processing Letters*, Vol. 105, No. 2, 58-64, 2008.

Ben-Moshe, B., Bhattacharya, B.K., Shi, Q. and Tamir, A, Efficient algorithms for center problems in Cactus networks, *Theoretical Computer Science*, Vol. 378(3), 237-252, 2007.

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Pankaj Agarwal, Binay Bhattacharya and Sandeep Sen, "Improved algorithms for uniform partition of points", *Algorithmica*, Vol. 32, pp.32-52, 2002.

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B. K. Bhattacharya and S. Ghosh

"Characterizing LR-visibility polygons and related problems", *Geometry: Theory and Applications*,. 18, pp. 19-36, 2001.

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"An optimal algorithm to compute the smallest bridge between two convex polygons", *Processing Letters*, Vol. 79, 215-221, 2001.

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"Efficient algorithms for the weighted 2-center problem in a cactus graph",of ISAAC, 2005 (Invited to a special issue).
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- Robert Benkoczi, Binay Bhattacharya, Sandip Das and Jeff Sember, Collection depots problems in the plane. Proc. of CCCG, 2005. (Invited to a special issue of Computational Geometry: Theory and Applications.)
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## Industry Sponsored Activities

We are focused on developing a comprehensive vehicle routing system that adapts to the particularities of urban scheduling. Our powerful model for vehicle scheduling in cities operates according to the following conditions:

- (a) New job requests are handled in real time. Each job is associated with particular time slots.
- (b) The scheduler maintains a schedule in real time.
- (c) The vehicle locations are monitored constantly; changes in the schedule, if needed, are updated.
- (d) The road systems in the city are being monitored by accessing live data such as the GPS feeds of the transfer vehicles. The average speed of the road networks is appropriately altered to reflect the current situation.
- (e) The point-to-point travel time/distance is computed on the fly.

We completed a major revision to our courier scheduling prototype incorporating the new constraints of the industrial partner. We submitted our formal report to the industrial partner. I supervised about three programmers over the year. I have invested a significant amount of time and resources on the development of this prototype. The developed prototype has over 25,000 lines of codes.

LIMOUSINE SCHEDULING IN OTTAWA REGION. This is a part of MITACS project sponsored by an industrial partner. A prototype has been built for the industrial partner. The prototype has been tested extensively by the partner. The prototype was later commercialized in 2008.

Finished developing a prototype for the same-day pickup-and-delivery courier schedule in Greater Vancouver area. (Sponsor: Dynamex Inc.) The project was finished in 2006.

Built a prototype to schedule patients' transfer between hospitals/care-homes by ambulances in Greater Vancouver area.

(Sponsor: FDM software)

Built a prototype to schedule vehicles to distribute modems to customers in Atlanta metropolitan area. (Sponsor: Dynamex Inc.)

Finished developing a system to estimate the travel times between locations in cities. The system has been tested on Greater Vancouver, Atlanta and Dallas road networks. (Sponsor: Dynamex Inc. and FDM software)

B.K. Bhattacharya, S. Mitrovic-Minic, The dynamic TSPTW on a line: Do preprocessing so that insertion of a new location into an existing route may be done in sublinear time, EURO/INFORMS Joint International Meeting, Istanbul, Turkey, July 6-10, 2003.

## Manuscript in Preparation

Binay Bhattacharya, Tsunehiko Kameda and Zhao Song, An Improved Algorithm for Finding p-Center in a Tree.

Z. Song, M. Ester and B. Bhattacharya, Discovering More Meaningful Regions: A Regularized Geographical Topic Model.



## Research/Project Funding - Received

**Contract/Grant:** Operating Grant **Awarded:** 2011 **Period:** 2011 - 2015  
**Project Title:** Design and analysis of location routing problems  
**Funding:** NSERC **Type:** External **Annual:** 24K **Total:** 120K  
**Involvement:** Principal Investigator

**Contract/Grant:** Research Grant **Awarded:** 2011 **Period:** 2011 - 2011  
**Project Title:** Facility location problems on a line  
**Funding:** MITACS **Annual:** 1.5K **Total:** 1.5K  
**Collaboration:** Globalink Project

**Contract/Grant:** Research Grant **Awarded:** 2011 **Period:** 2011 - 2011  
**Project Title:** Courier scheduling prototype  
**Type:** External **Annual:** 30K **Total:** 30K  
**Collaboration:** Industrial component of MITACS NCE

**Contract/Grant:** Research Grant **Awarded:** 2009 **Period:** 2010 - 2011  
**Project Title:** Facility location optimization  
**Funding:** MITACS **Type:** External **Annual:** 75K **Total:** 150K  
**Involvement:** Principal Investigator **Collaboration:** MITACS NCE Project  
**Institution of Co-Investigator(s):** SFU, UBC, McGill U., Lethbridge U.

**Contract/Grant:** Operating Grant **Awarded:** 2006 **Period:** 2006 - 2011  
**Project Title:** Applications of Computational Geometry to Optimization Problems  
**Funding:** NSERC **Type:** External **Annual:** \$32K **Total:** \$160K  
**Involvement:** Principal Investigator

**Contract/Grant:** Research Grant **Awarded:** 2010 **Period:** 2010 - 2010  
**Project Title:** Automatic part-nesting layout problem  
**Funding:** MITCAS **Annual:** 1.5K **Total:** 1.5K  
**Involvement:** Principal Investigator **Collaboration:** Globalink project

**Contract/Grant:** Research Grant **Awarded:** 2008 **Period:** 2008 - 2010  
**Project Title:** Facility Location Optimization  
**Funding:** MITACS **Type:** External **Annual:** \$75K **Total:** \$150K  
**Involvement:** Principal Investigator **Collaboration:** MITACS NCE Project  
**Institution of Co-Investigator(s):** SFU, UBC, McGill, Lethbridge

**Contract/Grant:** Research Grant **Awarded:** 2007 **Period:** 2007 - 2008  
**Project Title:** Personalized Traffic Alert  
**Funding:** Industry **Type:** External **Annual:** \$20K **Total:** \$20K  
**Involvement:** Principal Investigator **Collaboration:** Developing a prototype to estimate travel times in city networks

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**Contract/Grant:** Research Grant **Awarded:** 2006 **Period:** 2006 - 2008

**Project Title:** Facility location optimization

**Funding:** NCE-MITACS **Type:** External **Annual:** \$93K **Total:** \$186K

**Involvement:** Principal Investigator **Collaboration:** Involves researchers from SFU, UBC, Lethbridge, Carleton and McGill.

**Contract/Grant:** Research Grant **Awarded:** 2006 **Period:** 2006 - 2007

**Project Title:** Limousine Scheduling in Ottawa Region

**Funding:** Industry **Type:** External **Annual:** \$25K **Total:** \$25K

**Involvement:** Principal Investigator **Collaboration:** Developed a scheduling prototype for limousine taxis.

**Contract/Grant:** Research Grant **Awarded:** 2005 **Period:** 2005 - 2006

**Project Title:** Courier dispatching optimization

**Funding:** Dynamex Inc **Type:** External **Annual:** \$25K **Total:** \$25K

**Involvement:** Principal Investigator

**Contract/Grant:** Research Grant **Awarded:** 2004 **Period:** 2004 - 2006

**Project Title:** Facility location optimization

**Funding:** NCE-MITACS **Type:** External **Annual:** \$80K **Total:** \$160K

**Involvement:** Principal Investigator **Collaboration:** Involves researchers from SFU, UBC, Lethbridge, U.Sask, Carleton and McGill.

**Contract/Grant:** Operating Grant **Awarded:** 2001 **Period:** 2001 - 2005

**Project Title:** Applications of Computational Geometry to Optimization Problems

**Funding:** NSERC **Annual:** \$33.3K **Total:** \$133.2K

**Involvement:** Principal Investigator

**Contract/Grant:** Research Grant **Awarded:** 2004 **Period:** 2004 - 2004

**Project Title:** Patients' transfer scheduling in Greater Vancouver

**Funding:** FDM Software **Type:** External **Annual:** \$10K **Total:** \$10K

**Involvement:** Principal Investigator **Collaboration:** Developed a patient's transfer scheduling prototype for FDM Software.

**Contract/Grant:** Research Grant **Awarded:** 2003 **Period:** 2003 - 2004

**Project Title:** Facility location optimization

**Funding:** NCE MITACS **Type:** External **Annual:** \$80K **Total:** \$80K

**Involvement:** Principal Investigator **Collaboration:** Involves researchers from UBC, U.Sask, Carleton and McGill.

**Contract/Grant:** Research Grant **Awarded:** 2003 **Period:** 2003 - 2004

**Project Title:** Courier dispatching optimization

**Funding:** Dynamex Inc **Type:** External **Annual:** \$25K **Total:** \$25K

**Involvement:** Principal Investigator **Collaboration:** Designing a courier dispatching prototype for Dynamex.

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**Contract/Grant:** Research Grant **Awarded:** 2002 **Period:** 2002 - 2003

**Project Title:** Robust algorithms for GIS applications

**Funding:** Safe Software **Type:** External **Annual:** \$12K **Total:** \$12K

**Involvement:** Principal Investigator **Collaboration:** Designing robust geometric algorithms for some GIS problems

**Contract/Grant:** Research Grant **Awarded:** 2001 **Period:** 2001 - 2003

**Project Title:** Facility Location Optimization

**Funding:** NCE MITACS **Annual:** \$100K **Total:** \$200K

**Involvement:** Principal Investigator **Collaboration:** Involves researchers from UBC, U.Sask, Carleton, McGill

**Contract/Grant:** Research Grant **Awarded:** 2002 **Period:** 2002 - 2002

**Project Title:** Courier dispatching optimization

**Funding:** Dynamex **Annual:** \$10K **Total:** \$10K

**Involvement:** Principal Investigator **Collaboration:** Designing a courier dispatching prototype.

**Contract/Grant:** Research Grant **Awarded:** 2000 **Period:** 2000 - 2001

**Project Title:** Facility Location Optimization

**Funding:** NCE MITACS **Annual:** \$90K **Total:** \$90K

**Involvement:** Principal Investigator **Collaboration:** Involves researchers from UBC, U.Sask, Carleton, McGill.

**Contract/Grant:** Research Grant **Awarded:** 1999 **Period:** 2000 - 2001

**Project Title:** Courier Scheduling Optimization

**Funding:** Webdispatchers Co. **Annual:** \$25K **Total:** \$10K (received)

**Involvement:** Principal Investigator

**Contract/Grant:** NSERC CRD Grant **Awarded:** 1999 **Period:** 1999 - 2001

**Project Title:** Automatic Design of Kanji Characters

Investigator: Tiko Kameda

**Funding:** NSERC **Annual:** \$80K **Total:** \$80K

**Involvement:** Joint Investigator **Collaboration:** Automatic Design of Kanji characters. The project was discontinued due to disagreement with the University and the sponsoring company over the intellectual rights.

**Contract/Grant:** Operating Grant **Awarded:** 1997 **Period:** 1997 - 2001

**Project Title:** Application of Computational geometry to Pattern Recognition

**Funding:** NSERC **Annual:** \$31,000 **Total:** \$124,000

**Involvement:** Principal Investigator

**Contract/Grant:** Research Grant **Awarded:** 1999 **Period:** 1999 - 2000

**Project Title:** Facility Location Optimization

**Funding:** NCE-MITACS **Annual:** \$90,000 **Total:** \$135,000

**Involvement:** Principal Investigator **Collaboration:** Involves researchers from UBC, U.Sask, Carleton, McGill

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**Contract/Grant:** Research Grant **Awarded:** 1999 **Period:** 1999 - 2000

**Project Title:** Courier Scheduling

**Funding:** Quatronix **Annual:** \$15,000 **Total:** \$15,000

**Involvement:** Principal Investigator **Collaboration:** Developing efficient methods to scheduling courier activities in Lower Mainland.

**Contract/Grant:** Research Grant **Awarded:** 1999 **Period:** 1999 - 2000

**Project Title:** Call Assignment in Call-Center Environment

**Funding:** Soundlogic **Annual:** \$25,000 **Total:** \$25,000

**Involvement:** Principal Investigator **Collaboration:** Designing a real time system that will determine the optimal distribution of outgoing calls given the current response rate and the distribution of operators.

**Contract/Grant:** Operating Grant **Awarded:** 1992 **Period:** 1993 - 1997

**Project Title:** Application of Computational Geometry to Pattern Recognition

**Funding:** NSERC **Annual:** \$22,000 **Total:** \$88,000

**Involvement:** Principal Investigator

**Contract/Grant:** Equipment Grant **Awarded:** 1994 **Period:** 1994 - 1994

**Funding:** NSERC **Annual:** \$37,000 **Total:** \$37,000

**Involvement:** Principal Investigator **Collaboration:** Arvind Gupta (Joint Principal Investigator)

**Contract/Grant:** Operating Grant **Awarded:** 1988 **Period:** 1989 - 1993

**Funding:** NSERC **Annual:** \$20,000 **Total:** \$80,000

**Involvement:** Principal Investigator

**Contract/Grant:** Other Grant **Awarded:** 1991 **Period:** 1991 - 1992

**Project Title:** Application of Computational Geometry to Data Base Applications

**Funding:** CSS **Annual:** \$80,000 **Total:** \$80,000

**Collaboration:** Prof. W.S. Luk, Prof. J-W Han, Prof T. Poiker and Prof. T. Shermer

**Institution of Co-Investigator(s):** Simon Fraser University

**Contract/Grant:** Other Grant **Period:** 1989 - 1992

**Funding:** BNR **Annual:** \$20,000 **Total:** \$20,000

**Involvement:** Principal Investigator

**Contract/Grant:** Equipment Grant **Period:** 1990 - 1990

**Funding:** NSERC **Annual:** \$50,000 **Total:** \$50,000

**Involvement:** Joint Investigator **Collaboration:** Prof. Pavol Hell, Prof. Art Liestman, Prof. Joseph Peters

**Institution of Co-Investigator(s):** Simon Fraser University

**Contract/Grant:** Research Grant **Awarded:** 1985 **Period:** 1986 - 1989

**Funding:** NSERC **Annual:** \$20,000 **Total:** \$60,000

**Contract/Grant:** Operating Grant **Awarded:** 1982 **Period:** 1983 - 1986

**Funding:** NSERC **Annual:** \$17,980 **Total:** \$53,940

# **Binay Bhattacharya**

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**Contract/Grant:** Research Grant **Period:** 1982 - 1986

**Project Title:** President's Research Grant

**Funding:** Simon Fraser University **Annual:** \$4,500 **Total:** \$4,500

**Involvement:** Principal Investigator

**Contract/Grant:** Operating Grant **Awarded:** 1981 **Period:** 1982 - 1983

**Funding:** NSERC **Annual:** \$11,660 **Total:** \$11,660