



ANNUAL REPORT

Graduate Program in Operations Research

July 1, 2006—June 30, 2007

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I. Students

A. Enrollment

During Fall 2006 semester fifty-nine (59) students were enrolled in the Operations Research Program consisting of thirty-one (31) Ph.D. students, seventeen (17) MS and eleven (11) MOR students. Of these, twenty (34%) were new, twenty-one (36%) were female, eight (14%) were African American, and twelve (20%) were US students. Two students (Michelle Hill and Reza Yaesoubi) co-majored with Industrial Engineering.

Beginning Spring 2007 one (1) student was admitted, three (3) graduated and one (1) went on leave decreasing the enrollment to fifty-six (56). In Spring 2007 there were twenty-nine (29) Ph.D. students, sixteen (16) MS and eleven (11) MOR students.

The enrollment summary is provided in APPENDIX A, and a breakdown of OR students classified by department codes is show in APPENDIX B.

B. Degrees Conferred

The program was very productive during the academic year. It graduated a total of sixteen (16) students [five (5) Ph.D., eight (8) MOR, three (3) MS] in Operations Research (including those who graduate in Summer 2007). The names of the graduating students, the degrees awarded and student advisors are listed in APPENDIX C.

C. Recruiting

The Operations Research Admission Committee consisted of Drs. Devetsikiotis (ECE), Chao (IE), Sivaramakrishnan (Math), Medhin (Math), and Fathi (IE). The program received one hundred thirteen (113) applications for admission for Fall 2007 (a 10% increase compared with 2006). From these applicants, ninety-three (93) students were accepted for admission, and from these, we expect nineteen (19) students will start their program at the beginning of the Fall Semester. A complete breakdown of the list of applicants in various categories is included in APPENDIX D.

D. Awards and Honors

The qualifications and performances of the OR students were well recognized. Six (10%) of the students received scholarships or fellowships during the academic year. The list includes Dean's Fellowship and United States Army scholarships.

Xinmin Wu was nominated by the faculty to present his research at the poster session of the NC State Graduate Research Symposium on March 21, 2007.

Phil Koshute won the Elmaghraby Award and six (6) students were inducted into the Omega Rho International Honor Society. The complete list of honors and awards received by OR students is included in APPENDIX E.

E. Ph.D. Qualifying Exam

The Ph.D. Qualifying Exam was administered during the week of August 14-18, 2006. A total of four (4) students registered for the exam. One student passed unconditionally and three with conditions. The names of the students and the examining committee are provided in APPENDIX F.

F. Student Support

During the 2006-2007 academic year, thirty-two (32) students were supported (21 on teaching assistantships and 11 on research assistantships). The details of the TA/RA assignment are given in APPENDIX G. The OR program would like to recognize the following departments for their support: College of Management, Computer Science, Industrial Engineering, Mathematics, and Statistics.

G. Ph.D. Candidates

During this academic year the following students passed their preliminary Ph.D. exams: Xinmin Wu (November 2006), Qing Zhang (December 2006) and Yipeng Yang (July 2007). Chuan Lin, Jie Zhong, Chung-Chien Hong, Dongkyoung Choe and Wei Zhang completed their Ph.D. degrees during 2006-2007 academic year.

H. Other Activities

The following students served as officers of the Student Chapter of INFORMS: Michelle Hill (President), Dennis Frank (Vice-President), Rachel Hawley (Treasurer) and Phil Koshute (Secretary). In the Spring semester Phil Koshute replaced Michelle Hill and served as the President.

II. Faculty

A. Co-Directors

Under the organizational structure reflecting the interdisciplinary nature of the Operations Research programs at NC State, Dr. Negash Medhin (Mathematics) and Dr. Yahya Fathi (Industrial Engineering) continued to serve as co-directors of the Operations Research Program.

B. Membership

The OR faculty consisted of fifty-seven (57) faculty members who have their academic appointments in 10 participating departments: Industrial Engineering (9), Mathematics (13), Computer Science (13), Statistics (5), Civil Engineering (4), Electrical and Computer Engineering (4), Mechanical and Aerospace Engineering (1), Management (4), Forestry (1), and Textiles (3). In June 2007 Dr. Bibhuti Bhattacharyya retired. Dr. Bhattacharyya was one of the founding faculty members of the OR program at NC State University. A listing of OR faculty members and academic departments is included in APPENDIX H.

C. Research and Publications

Not all faculty members participate to the same extent in the OR program; indeed some are only tangentially involved. This makes it difficult to provide accurate statistics on the activities of the OR faculty body. For a complete listing of research and publications of each faculty member please see the corresponding departmental annual report. Also the OR website includes links to all OR faculty personal web pages.

D. Honors and Awards

A research team led by Dr. George F. List, professor and head of Department of Civil, Construction, and Environmental Engineering, and Dr. William A Wallace, professor in the Department of Decision Sciences and Engineering Systems at Rensselaer Polytechnic Institution, was recognized for its innovation by the Intelligent Transportation Society of America (ITS America) in a ceremony held at the society's 2007 Annual Meeting and Exposition on June 5th.

Dr. Wenye Wang (Electrical and Computer Engineering) was awarded the Faculty Early Career Development Award from the National Science Foundation.

Dr. Harry Perros (Computer Science), Dr. Mike Devetsikiotis and Dr. Ioannis Viniotis (Electrical and Computer Engineering) received IBM faculty awards.

An Outstanding Alumnus Award from the College of Science of National Tsinghua University was awarded to Dr. Shu-Cherng Fang (Industrial & Systems Engineering).

Dr. Thom Hodgson (Industrial & Systems Engineering) received the C.A. Anderson Outstanding Faculty Award from the NCSUISE, Student Chapters of the Institute of Industrial Engineers, Alpha Pi Mu, and the Furniture Club.

E. Faculty Meetings

One faculty meeting was held in Spring 2007 semester. The minutes of this meeting is appended to this report as APPENDIX I.

III. Administration and Staff

A. Personnel

Ms. Barbara Walls continued as OR Program Assistant.

B. Facilities and Equipment

No moves occurred in this academic year.

Items purchased for student offices and computer labs included computers, scanner and chairs for student offices and computer lab. A PC Monitor was purchased for faculty and desk chair for Program Assistant. Detailed items are listed in APPENDIX J.

C. Seminar Series

Eight speakers were invited to give talks to OR students in Fall 2006 and five speakers were invited in Spring 2007. All seminars were well attended. A detailed listing of seminars is given in APPENDIX K.

D. OR Program Review

In preparation for an external review of the program scheduled for Spring 2008, a review committee was formed. This committee will serve as an advisory board throughout the review process. The following faculty members agree to serve on this committee:

- Dr. Xiuli Chao
- Dr. Salah Elmaghraby
- Dr. Shu-Cherng Fang
- Dr. Ralph Smith
- Dr. Hien Tran

IV. Recommendations and Concerns for the Future

The current structure of the OR program appears to function well. However, the support from COE, PAMS and the participating departments is essential to maintain program stability and quality.

APPENDIX A
OR Student Enrollment Summary

Enrollment	Fall 2006	Spring 2007
Total	59	56
Continued	39	55
New	20	1
Male	38	36
Female	21	20
PhD	31	29
MS	17	16
MOR	11	11
NC/Resident	11	11
USA	12	11
International	36	34

APPENDIX B Students

<u>Name</u>	<u>Degree</u>	<u>Code</u>
Abdelijawad, Karmel F.	MOR	OR
Akintunde, Adekunle	MOR	OR
Allen, Shanae	MS	ORM
Arney, Kristin	MS	OR
Asgharzadeh Talebi, Zohreh	DR	ORC
Blair, Edward Tilden	MOR	OR
Chawli, Vidhi	MOR	OR
Choe, Dong-Kyoung (Annie)	DR	ORM
Ding, Chian-Fen	DR	ORM
Erdogan, Saadet Ayca	DR	OR
Everette, Jeffrey	DR	ORI
Fickler, Michael	MOR	OR
Fink, J. Kingsley	MS	OR
Frank, Dennis	DR	ORS
Gandhi, Nishit	MS	ORI
Gao, Jing	DR	OR
Hawley, Rachel	MOR	ORM
Hill, Michelle	MS	OR
Hodge, Ronald	DR	ORI
Hong, Chung-chien	DR	ORM
Hurgel, Ege	MS	OR
James, Robert	MS	OR
Kabo, Adam	DR	OR
Karimi, Sahar	DR	ORM
Kim, So Yeon	DR	ORM
Koshute, Phillip	MS	ORM
Lightner, Carin Ann	DR	ORI
Lin, Chuan	DR	ORM
Lin, Frank (Yu-Min)	DR	ORI
Liu, Ning	DR	ORC
Liu, Zhe	DR	ORI
Lobo, Benjamin	MS	ORM
Mahale, Rahul	MS	ORC
McClusky, Doug	MS	ORC
McLachlan, Colin	MOR	ORI

<u>Name</u>	<u>Degree</u>	<u>Code</u>
Mehta, Pratik	MOR	ORI
Norouzi, Amirhosein	DR	ORI
Osborne, Susan	DR	OR
Pearson, Karen	MOR	ORM
Peng, Yuanyuan	DR	OR
Radhakrishnan, Alamelu	MS	ORM
Rudolph, Adam	MS	ORM
Salazer-Adams, Jason	MS	ORS
Sheikh, Najeeb	MOR	OR
Sullivan, Eric	MS	ORM
Sumpter, Raynard	MOR	ORI
Tanner, Richard	MOR	ORM
Thompson, Maya	MOR	ORM
Wan, Wei	DR	OR
Wen, Zhi	DR	ORS
Wu, Xinmin	DR	ORG
Yaesoubi, Reza	MS	ORI
Yang, Yipeng	DR	ORM
Yu, Lu	DR	OR
Zhang, Jingyu	DR	ORM
Zhang, Qing	DR	ORC
Zhang, Wei (Winnie)	DR	ORI
Zhang, Yuan	DR	ORS
Zhang, Zhe	DR	ORC
Zhong, Jie	DR	ORC

APPENDIX C

Graduate Degrees Awarded

December 2006		
Graduate	Degree	Advisor
Akintunde, Adekunle	MOR	Dr. Yahya Fathi
Chawla, Vidhi	MOR	Dr. Robert Handfield
Zhong, Jie	Ph.D.	Dr. Peter Wurman

May 2007		
Graduate	Degree	Advisor
Choe, Dong-Kyoung	Ph.D.	Dr. Steve Campbell
Hawley, Rachel	MOR	Dr. Negash Medhin
Hill, Michelle	MOR	Dr. Yahya Fathi
Hong, Chung-Chien	Ph.D.	Dr. Negash Medhin
Hurgel, Ege	MOR	Dr. Yahya Fathi
Koshute, Phil	MS	Dr. Xiuli Chao
Lin, Chuan	Ph.D.	Dr. Robert T. Buche
McClusky, Doug	MS	Dr. Kazufumi Ito
Pearson, Karen	MOR	Dr. Negash Medhin
Radhakrishnan, Alamelu	MS	Dr. Negash Medhin
Thompson, Maya	MOR	Dr. Negash Medhin

August 2007		
Graduate	Degree	Advisor
Sumpter, Ray	MOR	Dr. Negash Medhin
Zhang, Wei (Winnie)	Ph.D.	Dr. Shu-Cherng Fang

APPENDIX D
Recruiting – Fall 2007

	Applicants	Admitted	Enrolled
Number of Students	113	93	19
PhD Students	48	47	10
MS Students	61	42	7
MOR Students	4	4	2
Male	78	62	9
Female	35	31	10
International	90	72	10
US	23	21	9

Admission Committee	
Dr. Xiuli Chao	Member
Dr. Kartik Sivaramakrishnan	Member
Dr. Michael Devetsikiotis	Member
Dr. Negash Medhin	Co-Chair
Dr. Yahya Fathi	Co-Chair

APPENDIX E

Student Honors and Awards

Student	Scholarships
McLachlan, Colin	College of Engineering Dean's
Rudolph, Adam	College of Engineering Dean's
Arney, Kristen	United States Army
Everette, Jeffrey	United States Army
Fink, J. Kingsley	United States Army
James, Robert	United States Army
Blair, Edward	SAS Corporation

Student	Honor Societies & Awards
Hill, Michelle	Omega Rho International Honor Society
Liu, Zhe	Omega Rho International Honor Society
Pearson, Karen	Omega Rho International Honor Society
Radhakrishnan, Alamelu	Omega Rho International Honor Society
Wan, Wei	Omega Rho International Honor Society
Zhang, Zhe	Omega Rho International Honor Society
Koshute, Phil	Dr. Elmaghraby Distinguished Student

APPENDIX F
August 2006 Qualifying Exam

Exam Committee:

Linear Programming, Dr. Shu-Cherng Fang
Nonlinear Programming, Dr. Shu-Cherng Fang
Stochastic Processes, Dr. Xiuli Chao
Dynamical Systems, Dr. Salah Elmaghraby
Dynamic Programming, Dr. Ralph Smith
Chair, Dr. Negash Medhin

The following students took the 2006 Qualifying Exams:

Frank, Dennis
Kim, So Yeon
Liu, Zhe
Wen, Zhi

APPENDIX G
OR Student Assistantships 2006-2007

Source	Fall 2006			Spring 2007		
	TA	RA	Total	TA	RA	Total
Operations Research	5	1	6	5	1	6
College of Management	0	2	2	0	1	1
Computer Science	1	3	4	1	3	4
Industrial Engineering	3	2	5	2	2	4
Mathematics	11	3	14	11	3	14
Statistics	1	0	1	1	0	1
Totals	21	11	32	20	10	30

Type of Support	Fall 2006	Spring 2007
TA and Fellowship	2	1
TA	19	19
RA	11	10
Self Supported	19	21
Other	8	5
Totals	59	56

APPENDIX H

OR Faculty

<u>Name</u>	<u>Department</u>
John Baugh	Civil Engineering
Richard H. Bernhard	College of Management
E. Downey Brill	Civil Engineering
Robert Buche	Mathematics
Stephen L. Campbell	Mathematics
Xiuli Chao	Industrial Engineering
Rada Chirkova	Computer Science
Mike Devetsikiotis	Electrical and Computer Engineering
Salah E. Elmaghraby	Industrial Engineering
Shu-Cherng Fang	Industrial Engineering
Yahya Fathi	Industrial Engineering
Robert E. Funderlic	Computer Science
Subhashis Ghosal	Statistics
Robert Handfield	College of Management
Robert E. Hartwig	Mathematics
Thom J. Hodgson	Industrial Engineering
Duncan M. Holthausen	College of Management
Thomas L. Honeycutt	Computer Science
Ilse Ipsen	Mathematics
Kazufumi Ito	Mathematics
Jeffrey Joines	Textiles
Michael G. Kay	Industrial Engineering
C. T. Kelley	Mathematics
Russell E. King	Industrial Engineering
Zhilin Li	Mathematics
George List	Civil Engineering
David F. McAllister	Computer Science
Negash Medhin	Mathematics
Carl D. Meyer	Mathematics
Arne A. Nilsson	Electrical and Computer Engineering
Tao Pang	Mathematics
Harry Perros	Computer Science
S. Ranji Ranjithan	Civil Engineering
Thomas W. Reiland	Statistics
Stephen Roberts	Industrial Engineering

Joseph P. Roise	Forestry
George N. Rouskas	Computer Science
Carla D. Savage	Computer Science
Munindar P. Singh	Computer Science
Kartik Krishnan Sivaramakrishnan	Mathematics
Ralph C. Smith	Mathematics
Charles E. Smith	Statistics
Matthias F. Stallman	Computer Science
Leonard Stefanski	Statistics
William J. Stewart	Computer Science
Moon W. Suh	Textiles
Kristin Thoney-Barletta	Textiles
Hien T. Tran	Mathematics
Ioannis Viniotis	Electrical and Computer Engineering
Mladen A. Vouk	Computer Science
Wenye Wang	Electrical and Computer Engineering
Don Warsing	College of Management
James R. Wilson	Industrial Engineering
Fen Wu	Mechanical & Aerospace
Peter Wurman	Computer Science
Ting Yu	Computer Science
Zhao-Bang Zeng	Statistics

OR Faculty Emeritus

Bibhuti Bhattacharyya	Statistics, Professor Emeritus
John W. Bishir	Mathematics, Professor Emeritus
Joseph C. Dunn	Mathematics, Professor Emeritus
Clarence J. Maday	Mechanical & Aerospace, Professor Emeritus
Henry L. Nuttle	Industrial Engineering, Professor Emeritus
Elmor L. Peterson	Mathematics, Professor Emeritus

APPENDIX I

OR Faculty Meeting Minutes

April 24, 2007

Attendees: Dr. Yahya Fathi , Dr. S.C. Fang, Dr. Hien Tran, Dr. Negash Medhin, Dr. Richard Bernhard, Dr. Salah E. Elmaghraby, Dr. Kartik Sivaramakrishnan, Dr. Robert Buche, Dr. Michael Rappa, Dr. Downey Brill, Dr. Moon Suh, Phil Koshute (Student Representative) and Barbara Walls (OR Program Assistant).

Dr. Fathi opened the meeting.

Phil Koshute (Informs Student Representative) talked about student chapter activities during the current academic year. The student chapter organized two social activities for all students and faculty of OR (the Fall get-together and the Spring picnic). Informs representatives asked the OR Career Center liaison to prepare a list of companies interested in hiring OR graduates. Students used these lists at the Career Fairs and appreciated the information. Informs sponsored a Fall seminar featuring two recent OR graduates who shared their experiences in the workplace. Next year they are hoping to sponsor a seminar featuring OR graduates working in academia. Officers for 2006-2007 were President – Michelle Hill, Vice President – Phil Koshute, Treasurer – Dennis Frank and Secretary – Rachel Hawley. In the Spring semester Phil Koshute replaced Michelle Hill as President. Officers for 2007-2008 will be President – Adam Rudolph, Vice-President – Ben Lobo, Treasurer – Pratik Mehta and Secretary – Ayca Erdogan.

Dr. Michael A. Rappa introduced the Initiative for Advanced Analytics, an NCSU curriculum associated with SAS. This program is currently admitting students for Fall and recruiting faculty who would participate in the program. The Master of Science in Analytics (MSA) is an intensive 10-month professional degree designed to give students a thorough understanding of the tools, methods and applications of advanced analytics. Dr. Rappa described the current structure of the program and its curriculum, and stated that he will be happy to meet with faculty, adjunct faculty, and doctoral candidates who are interested in participating. He also encouraged the OR faculty to provide feedback on the proposed curriculum.

Minutes from the Spring 2006 OR Faculty meeting were approved as submitted.

Dr. Fathi presented summary data indicating there are a total of 59 students in the program during the 2006-2007 academic year; 20 new students; 38 male and 21 female; 31 PhD students and 28 Master's; and 36 international students. Graduate degrees awarded in 2006-2007 include 9 MOR, 2 MS and 5 PhD for a total of 16. He further stated that there has been a 20% increase in applications for Fall 2007 with 110 applications processed to date. Dr. Tran asked if there will be an increase in TA positions and Dr. Fathi said there had been no increase in TA positions in spite of the increase in enrollment.

Qualifying Exams will be held the week of August 13th. The examining committee consists of Dr. Steve Campbell (Dynamical Systems), Dr. Xiuli Chao (Stochastic Processes), Dr. Salah Elmaghraby (Dynamic Programming), Dr. Shu-Cherng Fang (Non-Linear Programming), and Dr. Kartik Sivaramakrishnan (Linear Programming). Dr. Chao agreed to prepare and grade the exam even though he will not be on campus during the exam period.

Dr. Medhin reported that the Graduate School Review was originally scheduled for Spring 2007 but it was postponed by the graduate school and it is now scheduled for Spring 2008.

Dr. Fathi stated an initiative to develop a Five Year BS/MS Program in collaboration with some affiliated departments. According to this plan some undergraduate courses would be replaced by their equivalent graduate level courses, and this would allow the student to complete a BS degree in an affiliated program and a masters degree in OR within a five year time period. Similar programs currently exist in some departments within NC State University. This program should attract high quality students who may go on to be PhD students. Dr. Tran asked if a practicum could be incorporated and Dr. Fathi said that it could. After some deliberations it was decided that Dr. Fathi and Dr. Medhin follow up on this subject to prepare a tentative plan for further discussion at a future meeting.

The only new business was the comment from Dr. Fathi and Dr. Medhin that our inability to make funding commitments beyond the initial two years for PhD students remains an ongoing concern and makes us less competitive in recruiting top candidates.

The meeting was adjourned at 5:10 pm.

APPENDIX J

Equipment Acquired

<u>Equipment</u>	<u>Location</u>
1 desk chair	Program Assistant Office
(7) Dell Precision 390's	Burlington and Daniels Labs
HP 5590 Scanner	Burlington Lab
4 computer chairs	Daniels Computer Lab
PC Monitor	Co-Director's office

APPENDIX K OR Seminar Series

Fall 2006

- Aug 29, 2006 Welcome Back/Orientation
- Sep 5, 2006 Dr. Andrej Kosir, University of Ljubljana, Slovenia
"On the Scalability and the Performance Optimization of Combinatorial Auction Solvers Using Isomorphs"
- Sep 26, 2006 Mr. Craig Holcomb and Dr. Brian Hunt, National Security Agency
"Summer Program for Operations Research Technology (SPORT)"
- Oct 3, 2006 Dr. Xin Chen, Department of Industrial and Enterprise Engineering of University of Illinois at Urbana-Champaign
"A Tractable Approximation of Stochastic Programming via Robust Optimization"
- Oct 17, 2006 Dr. Mark Lawley, Purdue University
"The Evolving Field of Healthcare Engineering: Perspectives, Examples and Challenges"
- Oct 20, 2006 Dr. W. Art Chaovalitwongse, Department of Industrial and Systems Engineering, Rutgers University
"Recent Advances and Applications of Optimization and Data Mining in Healthcare and Biology"
- Oct 24, 2006 Julie Simmons Ivy, Department of Operations and Management Science, University of Michigan
"Balancing Patient and Payer Preferences: A Maintenance Model-based Efficient Frontier for Breast Cancer Detection and Treatment"
- Oct 31, 2006 Pierre F. Maldague, Jet Propulsion Laboratory
"Planning for Space Exploration: Current Techniques and Future Challenges"
- Nov 7, 2006 Bobby Ninan (PhD May 2005), Chuan Lin (PhD Dec 2006)
Alumni Share Their Career Choices

Spring 2007

- Feb 6, 2007 Dr. Robert E. White, Dept of Math, NCSU
"Optimal Control of Populations Using Impulsive Culling"
- Feb 20, 2007 Dr. Kartik Sivaramakrishnan, Dept of Math, NCSU
"A Parallel Conic Interior Point Decomposition Approach for Block-Angular Semidefinite Programs"
- Feb 23, 2007 Dr. Nan Kong, Dept of Industrial and Management Systems Engineering, University of South Florida
"Applying Operations Research to Organ Transplantation and Allocation for System and Policy Improvement"
- Mar 20, 2007 Dr. Manoj Chari, SAS Institute, Cary, NC
"Some Optimization Applications at SAS Institute"
- Apr 20, 2007 Clayton D. Morgan
"Resource Allocation in Activity Networks Under Deterministic Conditions: A Geometric Programming Approach"