

Hari Jagannathan Balasubramanian

Assistant Professor of Industrial Engineering
University of Massachusetts at Amherst
Amherst, MA 01003

Also:

Visiting Research Appointment
Department of Health Sciences Research,
Mayo Clinic, Rochester, MN.

Education

- **Ph.D** in Industrial Engineering, August 2006
Arizona State University, Tempe, AZ, USA.
Thesis title: *Parallel machine bicriteria scheduling: some complexity results and the problem of interfering job sets*
Co-chairs: Dr. John Fowler and Dr. Ahmet Keha
- **Master of Science** in Industrial Engineering, August 2002
Arizona State University, Tempe, Arizona, USA.
Thesis title: *Minimizing total weighted tardiness for parallel batch machines with incompatible job families*
Co-Chairs: Dr. John Fowler and Dr. Matt Carlyle
- **Bachelor of Engineering** in Production Engineering, June 2000
Regional Engineering College, Trichy, Tamilnadu, India.
Undergraduate project title: *Multicriteria scheduling of flow shops using genetic algorithms*
Chair: Dr. S.G.Ponnambalam

Current and previous Appointments

- Sept 2008 - Present, Assistant Professor, Mechanical and Industrial Engineering, University of Massachusetts at Amherst.
- Aug 2008 - Present, Visiting Research Appointment, Department of Health Sciences Research, Mayo Clinic, Rochester, MN.
- Sept 2006 - August 2008, Postdoctoral Research Associate, Department of Health Sciences Research, Mayo Clinic, Rochester, MN
- Jan 2006 - July 2006, Graduate Research Associate, School of Global Management and Leadership, Arizona State University.
- Aug 2000 - December 2005, Graduate Research Associate, Modeling and Analysis of Semiconductor Manufacturing (MASM) lab (directed by Dr. John Fowler), Industrial Engineering, Arizona State University.

Research Interests

Operations research applied to healthcare delivery (applications in primary care, emergency care, prostate cancer screening, surgical suites), scheduling theory and algorithms, stochastic optimization, multicriteria optimization, metaheuristics.

Teaching

- **Spring 2009:** Instructor, MIE 597C *Operations Research in Healthcare*. Graduate level course on operations research applied to healthcare delivery and planning as well as medical decision making problems.
- **Fall 2008:** Instructor, MIE 620 *Linear Programming*. Graduate level course on the theory and algorithms of linear programming.
- **Spring 2007, 08, 09:** Co-Instructor, along with Brian Denton, for CTSC 5920, *Introduction to Health Systems Engineering*. The course introduced operations research and basic statistical methods as applied to healthcare delivery and planning as well as medical decision making problems to a clinical audience.
- **Spring 2008:** Guest Lecturer, for the class, *Operations Research in Hospitals* in Industrial Engineering department at Arizona State University.
- **Fall 2005:** Instructor for the undergraduate class, IEE 300, *Economic Analysis for Engineers*. Student strength: 64. Reviews available upon request.
- **Summer 2003:** Instructor for the graduate summer class, IEE 533, *Scheduling and network analysis of models*. Student strength: 5.

Graduated Students

1. Jan Hippchen (co-advised with Ana Muriel), Masters thesis title: Physician flexibility in primary care practices (Aug 2009)
2. Ekkehard Beck (co-advised with Philip Henneman), Masters thesis title: A discrete event simulation approach to resource management, process changes and task prioritization in emergency departments (Aug 2009)

Book Chapters/Articles/Essays (students in bold)

1. Balasubramanian, H., Denton, B., **Lin, M.**, “Managing physician panels in primary care”, book chapter forthcoming in the Handbook of Healthcare Delivery Systems to be published by Taylor and Francis (Editor: Yuehwern Yih).
2. Balasubramanian, H., “The resettlement of refugee farmers”, OR/MS Today, April 2009, Volume 36 (2) (special issue on international applications of operations research).

Refereed Journal Publications

1. Denton, B., Miller, A., Balasubramanian, H., and Huschka, T., Optimal allocation to surgery blocks to operating rooms under uncertainty, accepted in *Operations Research*.
2. **Berg, B.**, Nelson, H., Denton, B., Balasubramanian, H., Rahman, A., Bailey, A., and Lindor, K., A discrete event simulation model to evaluate the operational performance of a colonoscopy suite, in press in *Medical Decision Making*.
3. Balasubramanian, H., Fowler, J., Keha, A. and Pfund, M., Scheduling interfering job sets on parallel machines, *European Journal of Operational Research*, forthcoming.
4. Pfund, M., Balasubramanian, H., Fowler, J., Mason, S., and Rose, O., A multicriteria approach to scheduling wafer fabrication facilities, *Journal of Scheduling*, 11 (1), 2008, 29-47.
5. Mohan, S., Gopalakrishnan, M., Balasubramanian, H., and Chandrashekar, A., A log-normal approximation of activity duration in PERT using two time estimates, *Journal of the Operational Research Society* Vol 58, Number 6, 827-831, 2007.
6. Monch, L., Balasubramanian, H., Fowler, J., and Pfund, M., Heuristic scheduling of jobs on parallel batch machines with incompatible job families and unequal ready times, *Computers and Operations Research*, Vol 32 (11), 2005, 2731-2750.
7. Balasubramanian, H., Monch, L., Fowler, J.W., and Pfund, M.E., Genetic Algorithm based scheduling of parallel batch machines with incompatible job families to minimize total weighted tardiness, *International Journal of Production Research*, Vol 42 (8), 2004.
8. Ponnambalam, S., Balasubramanian, H., Kataria, M., and Gadicherla, A., A TSP-GA multi-objective algorithm for flow-shop scheduling, *International Journal of Advanced Manufacturing Technology*, Vol 23, 2004, 909-915.

Publications Under Review

1. Balasubramanian, H., Banerjee, R., Denton, B., Naessens, J., Wood, D., and Stahl, J., "Improving clinical access and continuity using physician panel redesign", submitted to the *Journal of General Internal Medicine*
2. Balasubramanian, H., Fowler, J., and Keha, A., The polynomial solvability of selected bicriteria scheduling problems with equal length jobs and release dates on parallel machines, first revision in the *Journal of Scheduling*.

Publications In Preparation (students in bold)

1. **Zhang, J.**, Balasubramanian, H., Denton, B., Shah, N., and Inman, B., Optimization of prostate biopsy referral decisions, for *Operations Research*
2. Henneman, P., Balasubramanian, H., and **Beck, E.**, Campbell, M. Using Discrete Event Simulation to Study the Impact of Resources, Process Changes and Task Prioritization on Patient Length of Stay, for *Academic Emergency Medicine*.

3. Henneman, P., **Beck, E.**, and Balasubramanian, H., Using discrete event simulation to study the impact of physician profitability on length of stay, for *Annals of Emergency Medicine*.
4. **Hippchen, J.**, Balasubramanian, H., Muriel, A.,. Physician flexibility in primary care practices, for *Manufacturing and Service Operations Management*.

Refereed Conference Publications (students in bold)

1. **Beck, E.**, Balasubramanian, H., Henneman, P., (2009), Resource management and process change in a simplified model of an emergency department. Proceedings of the Winter Simulation Conference, to appear.
2. **Khowala, K.**, Fowler, J., Keha, A., (2009) and Balasubramanian, H., Single machine scheduling with interfering job sets, Proceedings of the 4th Multidisciplinary Scheduling Conference, Dublin, Ireland.
3. Balasubramanian, H., Banerjee, R., Gregg, M., and Denton, B. (2007), Improving primary care access using simulation optimization. Winter Simulation Conference proceedings, Washington DC, pp. 1494-1500.
4. Balasubramanian, H., Fowler, J., and Keha, A., Bicriteria scheduling of equal length jobs with ready times on identical parallel machines, *Proceedings of the 2nd Multidisciplinary International conference on Scheduling, Theory and Applications (MISTA 2005)*, 112-122.
5. Monch, L., Balasubramanian, H., Fowler, J., Pfund, M. Minimizing Total Weighted Tardiness on Parallel Batch Process Machines using Genetic Algorithms, *Proceedings of the International Conference of Operations Research*, University of Klagenfurt, Austria, Sept2-5, 2002, pages 229-234.
6. Mohan, S., Gopalakrishnan, M., Chandrashekar, A., Derryberry, D., and Balasubramanian, H., Estimating PERT activity times with two time estimates, *Proceedings of the Decision Sciences Institute*, (DSI 2005), 16951-16956.
7. **Balasubramanian, H.**, Fowler, J., and Pfund, M., Single machine bicriteria scheduling using the apparent tardiness cost heuristic, *Proceedings of the Industrial Engineering Research Conference (IIE 2006, Orlando, Florida)*.
8. Carlyle, W., Fowler, J. , Pfund, M. , Abraham, R. , Balasubramanian, H. and A. Gadkari, Semiconductor Wafer Fabrication Subproblem Solution Procedures for the Shifting Bottleneck Heuristic, *12th Annual International Conference on Flexible Automation and Intelligent Manufacturing*, Dresden, Germany, July 15-17, 2002, pp. 1464-1471
9. Carlyle, W., Fowler, J., Pfund, M., Abraham, R., **Balasubramanian, H.**, Gadkari, A. Semiconductor Wafer Fabrication Sub-Problem Solution Procedures for the Shifting Bottleneck Heuristic, *Society of Manufacturing Engineers*, Technical Paper, NF02-269.

Grants

1. PI of *Improving primary care access using simulation optimization*, Award amount: \$10,000, Mayo Small Grants Program, Collaborators: Ritesh Banerjee, and Brian Denton. Brief Description: Using optimization methods to determine models of care in a primary care context. Specifically addressing issues with regard to timely access for patients and also patient continuity with physician.
2. PI of *Education Grant: Case studies in healthcare operations research*, Award amount: \$10,000, Mayo Center for Translational Science Activities. Developing a course for the Mayo Graduate School of Medicine that provides hands on training using self-contained case studies in healthcare operations research.

Invited Talks

1. "How should we design primary care physician panels?" Presented at a) Isenberg School of Management, University of Massachusetts, Amherst (March 2009) b) Blue Cross Blue Shield (BCBS), Minneapolis (Jan 2009) c) INFORMS Annual Conference, Washington DC, (Oct 2008) d) Ivey School of Business, University of Western Ontario (Jan 2008) e) Industrial Engineering, University of Wisconsin, Milwaukee f) Industrial and Systems Engineering, State University of New York, Buffalo (April 2008)
2. "Multicriteria scheduling: An application in semiconductor wafer fabrication and a discussion of some complexity results in the parallel machine environment" Presented at a) Binghamton University, New York (April 2006) and b) North Dakota State University (May 2006).

Conference Presentations

1. Balasubramanian, H., Wilson, A., Staffing for disease management: the third part payer perspective, INFORMS Annual Conference, 2009, San Diego, CA.
2. Balasubramanian, H., Hippchen, J., Muriel, A., Flexibility in primary care, INFORMS Annual Conference, 2009, San Diego, CA.
3. Zhang, J., Balasubramanian, H., Denton, B., Shah, N., Inman, B., A partially observable Markov decision process model for prostate cancer screening, INFORMS Annual Conference, 2009, San Diego, CA.
4. Schaefer, A., Balasubramanian, H., Batun, S., Denton, B., and Huschka, T., Multi-OR surgery scheduling problem with surgeon constraints, INFORMS Annual Conference, Washington DC, 2008.
5. Bailey, B., Balasubramanian, H., A capacity planning model for internal access within a large integrated academic practice, INFORMS Annual Conference, Washington DC, 2008.
6. Zhang, J., Balasubramanian, H., Denton, B., Shah, N., Inman, B., Optimization of prostate cancer screening decisions, INFORMS Annual Conference, Washington DC, 2008.
7. Inman, B., Zhang, J., Denton, B.T., Balasubramanian, H., Shah, N., Optimization of Prostate Cancer Screening Policies Using Partially Observable Markov Decision

Processes, 2009 Genitourinary Cancers Symposium, ASCO, Orlando, FL, February, 2009

8. Denton, B.T., Balasubramanian, H., Huschka, T., Miller, A., Stochastic and Robust Optimization of Multi-OR Surgical Schedules, INFORMS Annual Meeting, Seattle, November 2007
9. Balasubramanian, H., Fowler, J., Keha, A., Bicriteria Scheduling of Equal Length Jobs with Release Dates on Identical Parallel Machines, INFORMS Annual Conference, Seattle, 2007.
10. Denton, B.T., Nelson, H., Berg, B., Balasubramanian, H., Rahman, A., Bailey, A., Lindor, K., A Simulation Model to Predict the Performance of an Endoscopy Suite, University of Cincinnati Conference: Innovations in Health Care Delivery, Cincinnati, OH, October 2007
11. Denton, B.T., Miller, A., Balasubramanian, H. Stochastic Optimization of a Multi-OR Surgical Suite, Canadian Operational Research Society Annual Meeting, London, Ontario, Canada, May 2007
12. Balasubramanian, H., Denton, B.T., Rahman, A., Optimization of Outpatient Scheduling Decisions Under Uncertainty, INFORMS Annual Meeting, Pittsburgh, November 2006
13. Zhang, J., Balasubramanian, B., Denton, B.T., Inman, B., A Partially Observable Markov Decision Process to Determine Optimal PSA Based Biopsy Thresholds for Prostate Cancer, INFORMS Computing Society Conference, Charleston, SC, January 2009
14. Balasubramanian, H., Banerjee, R., Gregg, M., and Denton, B., Improving primary care access using simulation optimization, 33rd Operational Research Applied to Health Services meeting, St. Etienne, France, July 2007.
15. Balasubramanian, H., Denton, B., Rahman, A., "Optimization of a multi-OR surgical suite", INFORMS Annual Meeting, Pittsburgh, 2006.
16. Gopalakrishnan, M., Oke, A. and Balasubramanian, H., "Supply Chain Risks and management: An analysis of current knowledge", Production and Operations Management Society (POMS) meeting, Boston, April 2006.
17. Oke, A., Gopalakrishnan, M. and Balasubramanian, H., A framework for analyzing quality in a retail supply chain Production and Operations Management Society (POMS) meeting, Boston, April 2006.
18. Balasubramanian, H., Pfund, M.E., Fowler, J.W., and Mason, S.J., "A Bi-criteria approach to scheduling wafer fabrication facilities", Industrial Engineering Research Conference, Atlanta, 2006.
19. Gamalski, A., Muralidhar, V., Balasubramanian, H., and Fowler, J.W., "Minimizing total weighted tardiness on parallel machines with equal processing times and release dates", INFORMS Annual Meeting, San Francisco, 2005. (The above presentation developed from my mentoring activities with high school students, Andrew Gamalski of Hamilton High School, Tempe, Arizona and Vinayak Muralidhar of Corona Del Sol High School, Tempe, Arizona from Fall 2004-Summer 2006. The presentation at INFORMS, San Francisco was given by Andrew Gamalski.)

20. Balasubramanian, H., Monch, L., Fowler, J.W., and Pfund, M.E., "Minimizing total weighted tardiness on parallel batch machines with Incompatible Job Families", INFORMS Annual Meeting, San Jose, 2002.

Awards and honors

- Graduate and Fellow of the Preparing Future Faculty (PFF) program (Fall 2003 - Summer 2005), Arizona State University.
- INFORMS Annual Meeting: Doctoral Colloquium participant, 2005.
- Southwest Center for the Education and Natural Environment (SCENE): Scholarship (from years 2003-2006) to mentor high school students on industrial engineering research projects.
- Industrial Engineering, Arizona State University, Departmental Academic Commendation, 2003-2006.

Service Activities

- Summer 2007: In the organizing program committee of the 33rd annual international conference, Operations Research Applied to Health Services (ORAHHS), to be held from July 15-20 in Saint Etienne, France.
- April 2008: Cluster chair for health applications section of INFORMS Western Regional Conference, Phoenix, Arizona.
- Reviewer for *European Journal of Operational Research*, *IIE Transactions*, *International Journal of Production Research*, *Health Care Management Science*
- Fall 2003- Spring 2005: Vice-President of the ASU Student Chapter of INFORMS.