

*Welcome by Department Chair Nagaraj K. Neerchal*

It is a pleasure to bring to you the Spring 2011 issue of the department newsletter. This semester continued to showcase the achievements of both our faculty and students. We celebrated our 5th annual Probability and Statistics Day two day conference, for which over 200 participants registered! Not only did we have the honor of one of our graduating seniors chosen as the Class of 2011 Valedictorian, but also celebrated several successful completions of Master's and PhD degrees, and grants awarded to several of our faculty members. In this issue of our newsletter we are including a list of all faculty and student publications as an annual feature. Mrs. Roberta Butler joined us as our Administrative Assistant II, while we lost Ms. Tarsha Randolph to the Payroll Office. Some of our alumni who went to school in the nineties may remember Roberta (goes by Bobbie), who worked here for some time. Dr. Yen-Mow Lynn has announced his retirement, effective December 2011. We are hoping to be able to celebrate his more than 44 years of service to the university sometime this fall. Finally, I want to thank Ms. Angela McNulty who has agreed to take the primary responsibility of putting together this newsletter regularly. I would like all alumni to consider sending personal and professional news items about themselves to Angela to be included in future issues. So, I hope to hear from you soon and often.

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## *Undergraduate Alexandria Volkening chosen as Valedictorian for Class of 2011*



Valedictorian Alexandria Volkening (Math B.S.) gave a rousing speech to graduating students at this semester's Undergraduate Commencement Ceremony on May 23, 2011. In her speech to students, family, and faculty she stated that the Class of 2011 has been fortunate to receive their education at one of the most diverse schools in the country; something that she challenged every graduating senior to keep hold of as they move through life, explaining that everyone from different disciplines will need to work together in order to solve problems both closer to home and those on a larger scale. She also challenged the students to reach out of their comfort zone as a way of keeping a diverse community alive. Volkening asked everyone in the audience to stand up and yell out the UMBC chant with her, stating that "roaring out the UMBC chant as a community was my way of showing the students how loud our voices can be when we combine them with voices of other people who are different from us in a community." Alexandria ended her speech by declaring "Our voices are powerful when we raise them together. When you leave this arena today, remember this moment. Remember to always unite your voices with a diverse set of people. Because that's what the world needs. And, Class of 2011, we are exactly what the world has been waiting for."

In attendance were several Math and Stat faculty members, about whom Alexandria said "it was such a joy to have them sit in the front row and be part of the special day. It really calmed my nerves to have them there supporting me. I'm grateful."

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## *News from the Undergraduate Program*

Congratulations to the students who graduated this spring semester! One Stat B.S. major, four Stat minors, 26 Math B.S. majors, eight Math B.A. majors, and ten Math minors were awarded degrees in May. Congratulations to the seniors who have graduated with university honors: **Marc Zerfas, Michelle Brandenburg, Rachael Davis, Ashley Dyjack, Bhaba Joshi, Samuel Khuvis, Benjamin Klein, Victoria Kohl, Joshua Kruder, Matthew McAllister, Katherine Miller, Chimeziri Onyewu, Catherine Perry, Jacob Richeimer, Kaung San, and Oi In Tam** graduated Cum Laude; **David Mason, Anthony Simms, Abhinaya Thapa, and Amanda Wiater** graduated Magna Cum Laude; and **Zachary Ehudin, Gregory Handy, and Alexandria Volkening** graduated Summa Cum Laude.

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## *News from the Graduate Program by Program Directors Kathleen Hoffman and Anindya Roy*

Greetings from the Graduate Program Directors: We are happy to announce a very successful recruiting year. We welcome sixteen new students (eleven full-time and five part-time) in the applied mathematics program and eleven new students (three full-time and eight part-time) in the statistics program in the fall. We thank all our colleagues for their support in this important endeavor. We would like to congratulate our recent graduates and wish them every success in the future. We would also like to recognize the following students who received awards at the fifth annual student recognition day: **Yushu Yang** - Outstanding Graduate Research in Mathematics; **Xiaoyu Dong** - Outstanding Graduate Research in Statistics; **Matthew Frazier** - Outstanding Graduate Teaching Assistant in Mathematics; **April Albertine** - Outstanding Graduate Teaching Assistant in Statistics; **Paula Borrego** - Outstanding Graduate Teaching Assistant in Statistics; **Merve Gurlu** - CIRC Consultant of the Year.

We look forward to a successful and productive year!

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## *UMBC holds Biostatistics Workshop by Dr. Anindya Roy*



On March 12, 2011, the Department of Mathematics and Statistics organized a workshop on "Contemporary Statistical Methods in Biostatistics" in order to promote and celebrate the success of the biostatistics program, a joint venture between

UMBC, the University of Maryland School of Medicine, and the University of Maryland Marlene and Stewart Greenebaum Cancer Center. The workshop featured three world renowned keynote speakers: Dr. Paul Albert, Chief, Biostatistics and Bioinformatics Branch, DESPR, NICHD; Dr. Dean Follman, Chief & Associate Director, Biostatistics Research Branch, NIAID; and Dr. Nilanjan Chatterjee, Chief of the Biostatistics Branch, NCI. The program included many other outstanding talks by eminent researchers from NIH, FDA, and UMB medical school. There were seventy participants for the workshop. **Dr. Philip Rous**, Dean of the College of Natural and Mathematical Sciences, inaugurated the workshop with encouraging words for the joint venture in biostatistics. The workshop also featured awards for best poster based on an excellent poster session organized by the graduate students.

Overall the workshop was a phenomenal success, with healthy participation from both UMBC and UMB while attracting a large number of researchers from the health science community in the Baltimore-Washington area.

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## *News from the Council of Majors and Pi Mu Epsilon by President Victoria Kohl*

PME and the Math/Stat Council of Majors were busy this past spring planning and participating in many events. We hosted a Mobius Bagel Competition where students and staff were invited to cut a "Mobius Bagel". Students who were interested in Grad School were invited to attend our Graduate Panel where we discussed applying for graduate school, among other topics. PME and the Math/Stat COM participated in the Campus Activities Fair where we encouraged incoming freshmen to look into our events when they arrived in the fall. We also inducted new members into PME and successfully elected four new qualified officers: **Lauren Won** (President), **Rockford Foster** (Vice President), **Amanda Harris** (Treasurer), **Sean Leavy** (Secretary), **John Seymour** (General Member).

It has been a pleasure serving as PME/COM President this past year. I look forward to hearing about all of the events PME and COM will be hosting this fall and in the future.

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*News from the SIAM Student Chapter by President Jyoti Saraswat and Dr. Susan Minkoff*



It's been another busy year for the SIAM student chapter at UMBC. In February the chapter hosted a professional development seminar for graduate students in the department on "How to give a Research talk." The session was chaired by **Dr. Manil Suri** and was based on an article which appeared in the "Careers in Math Sciences Column" of SIAM News (Vol. 44, No. 3, April 2011, written by Drs. Kolda and Torczon - **Dr. Susan Minkoff**, faculty advisor for the UMBC SIAM chapter is editor of the Careers Column. At the end of February, a group of students attended the SIAM Computational Science and Engineering Conference in Reno, Nevada, which was host to SIAM Student Days this year. Our chapter was one of only a handful of the 90 SIAM student chapters worldwide to have been invited to send a student representative to participate in Student Days. Graduating doctoral student **Yushu Yang** gave a well-received talk in the Student Days session. In March the chapter helped co-sponsor the Mid-Atlantic conference with Shippensburg University in Pennsylvania, as well as a number of other local universities. While the main focus of this Mid-Atlantic conference was the presentation of research, it also provided a forum for the different chapters to share their experiences and ideas for activities. Invitation and support of the keynote speaker for the conference (Dr. Andrew Conn, of IBM TJ Watson Research Center in New York) was the UMBC chapter's primary contribution to the conference. **Jyoti Saraswat**, President of the SIAM Student Chapter at UMBC, was presented with the SIAM Certificate of Recognition for her dedicated work with the student chapter.

The chapter officers for 2010-2011 are **Jyoti Saraswat** (President), **David Trott** (Vice President), **Jonathan McHenry** (Secretary), **Kyle Stern** (Treasurer), and **Zana Coulibaly** (Webmaster). The chapter faculty advisor is **Dr. Susan Minkoff**. More information about our chapter and its activities can be found at <http://www.umbc.edu/studentlife/orgs/siam>

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*News from the MSGSA by President Paula Borrego*

Over the past semester, the MSGSA hosted several meetings in which we socialized, had pizza, and heard from a number of guest speakers. Over the course of the semester, our speakers included **Dihua Xu**, **Yushu Yang**, **Jyoti Saraswat** and **Andrew Raim**, who shared their experiences and offered advice on subjects ranging from choosing advisors to attending conferences.

The MSGSA Facebook group was created to facilitate communication among students, including the formation of study groups, suggestions on classes and books, announcements, and reminders of GSA events, and pictures of our events. Students, please make sure you are part of it! We have been meeting regularly for lunch at True Grits on Thursdays at 1:00 pm to take advantage of the discounted price for graduate students and to have a little break. Finally, we hosted a picnic at the end of the semester at an outdoor pavilion where we played volleyball, soccer, badminton, and hula hoops! We were pleased to have so many faculty attend with their families.



*MSGSA 2011-2012 Officers (from left to right): **April Albertine**, Vice President; **Nicole Masserelli**, Secretary; **Amanda Peterson**, Senator; **Paula Borrego**, President; **Elande Baro**, Treasurer*

Next semester we will continue with our pizza meetings. We are also planning to take part in a community service activity at Moveable Feast (<http://www.mfeast.org/>) and of course, a Christmas party is in the works. Please stay tuned for news of our events! We're looking forward for a wonderful semester!

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## *Two Journal Publications for CIRC Students and Synergy with HPCF*



The Center for Interdisciplinary Research and Consulting (CIRC) in the Department of Mathematics and Statistics makes the expertise of the department's faculty and students available to the community both on- and off-campus. One outcome of long-term collaboration with one of our clients is a paper involving former HPCF Research Assistant, **Alen Alexanderian** (now a post-doc at Johns Hopkins University) which was accepted for publication this spring. The paper, entitled "An Age-Structured Model for the Spear of Epidemic Cholera: Analysis and Simulation," is co-authored by **Alen Alexanderian, Matthias K. Gobbert**, Renee Fister, Holly Graff, Suzanna Lenhart, and Elsa Schaefer, and will appear in the journal *Nonlinear Analysis: Real World Applications*. A second collaboration between CIRC and regular client Dr. Mukund Didolkar from Sinai Hospital of Baltimore resulted in another published paper. Authored by Mukund S. Didolkar, Cardella W. Coleman, Mark J. Brenner, Kyo U. Chu, Nicole Olexa, **Elizabeth Stanwyck, Airong Yu, Nagaraj K. Neerchal**, and Stuart Rabinowitz, the paper "Image-Guided Stereotactic Radiosurgery for Locally Advanced Pancreatic Adenocarcinoma Results of First 85 Patients" is showcased in the *Journal of Gastrointestinal Surgery*.

CIRC continued its series of software workshops in cooperation with the UMBC Division of Information Technology and hosted another workshop on the FEM package COMSOL Multiphysics, taught by a COMSOL engineer as part of this series. Please see [www.comsol.com](http://www.comsol.com) for more information.

CIRC also continued its synergistic collaboration with the UMBC High Performance Computing Facility ([www.umbc.edu/hpcf](http://www.umbc.edu/hpcf)), when the HPCF Research Assistants **Andrew Raim** and **David Trott** met with users of HPCF for free, individual user support in consulting format. The Spring 2011 CIRC students were **Kyle Stern, Xiao-Song Zhong, Paula Borrego**, and **Merve Gurlu**. **Gurlu** is CIRC consultant of the year for her work with one of our clients analyzing data on the effectiveness of high school counselors' advice on college choice.

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## *5<sup>th</sup> Annual Probability and Statistics Day*



This year marked our 5<sup>th</sup> annual Probability and Statistics Day conference and workshop. Twenty-eight colleges and universities and 22 government or private agencies from 22 different US states and countries were represented by over two hundred participants. Keynote speeches, invited sessions, and student poster and oral presentations were the highlights of this year's two day event.

The conference started on Friday, April 22 with a workshop on "Synergistic Statistics and Graphics in Safety Reviews of Clinical Trials" presented by **Dr. Russ Wolfinger** (Director of Scientific Discovery, SAS Institute) and assisted by **Dr. Kelci Miclus** (SAS Institute). Participants were encouraged to bring their own laptop to this interactive session so that they could follow along and explore the results. Ninety statisticians attended this half-day workshop. The conference continued on Saturday, April 23 with a welcome speech by **Dr. Philip Rous**, Dean of the College of Natural and Mathematical Sciences, in which he praised the statistics faculty for their contributions toward establishing a solid graduate statistics program, and also emphasized UMBC's role in promoting science education in

the Baltimore-Washington area. Following opening speeches by **Dr. Nagaraj Neerchal** and **Dr. Bimal Sinha**, **Professor Jun Shao** (University of Wisconsin-Madison) and **Professor Dennis Cox** (Rice University) presented their keynote addresses. Three parallel sessions continued the morning segment, featuring two graduate student oral presentations and an international invited session that included speakers from Canada, Portugal, Poland, and Germany. The third keynote address of the day was presented by **Professor Marie Davidian** (North Carolina State University) and was followed by a second invited session of UMBC alumni, including talks from **Inna Perevozskaya** (Pfzier; PhD, 2000), **Justin Newcomer** (Sandia National Lab; PhD, 2009), and **Martin Klein** (US Census Bureau; PhD, 2009). Graduate student posters were on display all day and were evaluated by a panel of judges. Certificates of recognition and cash prizes were awarded to the top student presenters for both oral and poster presentations during the afternoon award ceremony. Alumni **Barbara Lingg** (treasurer of the Maryland Chapter of the ASA) was also recognized and presented with plaques during the award ceremony. The day-long conference came to a close with a banquet dinner and speech presented by **Dr. Larry Cox** (Assistant Director, National Institute of Statistical Sciences). Over one hundred participants were in attendance at this year's conference.

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## *Kudos*

We gratefully acknowledge the following people who have donated generously to the Department of Mathematics and Statistics in the past year. We hope many more will join them. If you want to find out how to donate, please email [nagaraj@umbc.edu](mailto:nagaraj@umbc.edu).

Dr. Nabendu Pal; Mr. Stephen Morck and Mrs. Jeanne Morck; Ms. Ying Hu; **Dr. Joseph Warfield**; Dr. Wen-Jong Shyong; Dr. Amit Bhattacharyya; Dr. Inna Perevozskaya; Mrs. Pallavi Pal; **Dr. Muddappa Gowda**; **Dr. Matthias Gobbert**; **Dr. James Lo**; **Dr. John Zweck**; **Dr. Manil Suri**; **Dr. Bimal Sinha**; Mrs. Suchandra Sinha

The following grants have been awarded to our faculty:

- **Dr. Susan Minkoff** was awarded funding for the Infinite Possibilities Conference to be held at UMBC in March 2012 from both the National Science Foundation and the National Security Agency.
- **Dr. Yi Huang**, co-PI, was awarded \$50,000 as part of the 2011 FDA Critical Path Grant. Dr. Cunlin Wang from the FDA is the PI of this grant entitled "Average Treatment Effect Estimation Accounting for Covariate Measurement Error – Method Extension and Software Development."
- **Drs. John Zweck and Susan Minkoff** have been awarded a grant from the National Science Foundation Engineering Research Center on Mid InfraRed Technologies for Health and the Environment (MIRTHE) to optimize the design of a new generation of trace gas sensors based on quantum cascade lasers and quartz tuning forks. The project is in collaboration with the Laser Science Group at Rice University.
- **Dr. Thomas Mathew** has been selected to be an Associate Editor of the Journal of the American Statistical Association
- A short movie about the inaugural 2010 REU Site: Interdisciplinary Program in High Performance Computing program is now on YouTube (<http://www.youtube.com/watch?v=FO38SdaPNdQ>). The video includes opening remarks by UMBC President **Freeman Hrabowski, III** and testimonials from participants **Teresa Lebair** and **Michael Curtis**. Teresa is now a new graduate student in the Applied Mathematics program at UMBC and Michael is a mathematics and computer science double major. The REU Site program is co-directed by **Drs. Matthias Gobbert** and **Nagaraj Neerchal**. For more information on the REU program, please see [www.umbc.edu/hpreu](http://www.umbc.edu/hpreu). We are grateful to the DoIT New Media studio for putting this together for us.
- Mathematics graduate student, **Mattie Whitmore**, has successfully defended her Master's Thesis entitled "Modeling and Simulation of Groundwater Flow and Contaminant Transport in a Cross-Section of the Delmarva Peninsula" under the direction of **Dr. Brad Percy** and Dr. Matthew Baker (GES) with **Dr. Matthias Gobbert** as a committee member.

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## ***Faculty and Graduate Student Publications 2010***

- K. Kochareon, Y. Lenbury, and **J. Bell**. (2010). Dynamical analysis of a model of skeletal muscles with myotonia or periodic paralysis. *Journal of Nonlinear Studies* 1(2) (2010), 1-20.
- D. Cornwell** (2010). The Amplified Quantum Fourier Transform. arXiv:1010.0033v1 [quant-ph], *Quantum Physics*.
- D.W. Trott and M. K. Gobbert** (2010). Conducting Finite Element Convergence Studies using COMSOL 4.0. In: Yeswanth Rao, editor, *Proceedings of the COMSOL Conference 2010*, Boston, MA, 6 pages
- M.S. Gowda** and R. Sznajder (2010). Schur complements, Schur determinantal and Haynsworth inertia formulas in Euclidean Jordan algebras. *Linear Algebra and its Applications*, 432, 1553-1559.
- M.M. Moldovan and M.S. Gowda**. (2010). On common linear/quadratic Lyapunov functions for switched linear systems in Nonlinear Analysis and Variational problems. *Springer Optimization and its Applications*, Vol. 35, pp. 415-429, Springer, New York.
- W. Kang** and K. Ramanan (2010). Fluid limits of many-server queues with reneging. *Annals of Applied Probability*, Volume 20, Number 6, 2204-2260.
- W. Kang** and K. Ramanan (2010). A Dirichlet process characterization of a class of reflected diffusions. *Annals of Probability*, Volume 38, Number 3, 1062-1105.
- J. Lo** (2010). Functional Model of Biological Neural Networks. *Cognitive Neurodynamics*, Vol. 4, Issue 4, pp. 295-313.
- J. Lo** (2010). Unsupervised Hebbian learning by recurrent multilayer neural networks for temporal hierarchical pattern recognition. *Proceedings of the 44th Annual Conference on Information Systems and Sciences*.
- J. Lo** (2010). Convexification for Data Fitting. *Journal of Global Optimization*, 46, pp. 307-315.
- T. Mathew** and K. Nordstrom (2010). Comparison of one-step and two-step meta-analysis models using individual patient data. *Biometrical Journal*, 52, 271-287 (2010).
- L. Zhang, **T. Mathew**, H. Yang, K. Krishnamoorthy and I. Cho (2010). Tolerance limits for a ratio of normal random variables. *Journal of Biopharmaceutical Statistics*, 20, 172-184.
- P.J. Fagan, A.B. Schuster, C. Boyd, J.A. Marsteller, M. Griswold, **S.M.E. Murphy**, L. Dunbar, and C.B. Forrest (2010). Chronic Care Improvement in Primary Care: Evaluation of an Integrated Pay-for-Performance and Practice-Based Care Coordination Program among Elderly Patients with Diabetes. *Health Services Research*, 45(6), 1763-1782.
- W. Tang, K. McDowell, M. Limsam, **N.K. Neerchal**, P. Yarowsky, U. Tasch (2010). Locomotion Analysis Sprague-Dawley Rats before and after injecting 6-OHDA. *Behavioural Brain Research*, 210, 131-133.
- P. Lim, E. Kang, and **D. Park** (2010). Learning Curve and Surgical Outcome for Robotic-Assisted Hysterectomy with Lymphadenectomy: Case-Matched Controlled Comparison with Laparoscopy and Laparotomy for Treatment of Endometrial Cancer. *Journal of Minimally Invasive Gynecology*, 17, 739-748.
- J. Park** (2010). The Generalized P-value in one-sided testing in two sample multivariate normal populations, *Journal of Statistical Planning and Inference*, Vol.140, 1044-1055.
- J. Park** and J.K. Ghosh (2010). A Guided Random Walk Through Some High Dimensional Problems. *Sankhya Ser.A*. Vol.72, 81-100.
- B. E. Percy** and A. Sherman (2010). How Pancreatic Cells Discriminate Long- and Short-Time Scale cAMP Signals. *Biophysical Journal*, 99, Issue 2, 398-406.
- S. Al-Homidan, M.M. Alshahrani, C.G. Petra, and **F.A. Potra** (2010). Minimal condition number for positive definite Hankel matrices using semidefinite programming. *Linear Algebra and Its Applications*, 433, 6, 1101--1109.

- F.A. Potra** and E. Simiu (2010). Multihazard Design: Structural Optimization Approach. *Journal of Optimization Theory and Applications*, 144, 120--136.
- A. M. Soane and **R. Rostamian** (2010). Variational problems in weighted Sobolev spaces on non-smooth domains. *Quarterly Journal of Applied Mathematics*, 68, no. 3, 439-458.
- Y. Zheng, J. Zhu, and **A. Roy** (2010). Nonparametric Bayesian inference for the spectral density function of a random field. *Biometrika*, 97, 238-245.
- M. Novey, T. Adali, and **A. Roy**. (2010). A complex generalized Gaussian distribution- characterization, generation, and estimation. *IEEE Trans. Signal Processing*, 58, 1427-1433.
- J. Betz**, J. Zhuo, **A. Roy**, K. Shammuganathan and R.P. Gullapalli (2010). Prognostic Ability of Diffusion Tensor Imaging Parameters among Severely Injured Traumatic Brain Injury Patients. K. E. Herold, W. E. Bentley, and J. Vossoughi (Eds.) *SBEC, IFMBE Proceedings*, 32, pp 38-42.
- J. Hu, **J. Shen**, and W. Zhang (2010). A Generating Function Approach to the Stability of Discrete-time Switched Linear Systems. *The 13th International Conference on Hybrid Systems: Computation and Control (HSCC)*, pp. 273–282, Stockholm, Sweden.
- Q. Hui, **J. Shen**, and W. Qiao (2010). Dynamic Security Analysis of Electric Power Systems: Passivity-Based Approach and Positive Invariance Approach. *Proceedings of the 3rd ASME Dynamical Systems and Control Conference*, Boston, MA.
- J. Shen** (2010). Observability Analysis of Conewise Linear Systems via Directional Derivative and Positive Invariance Techniques. *Automatica*, Vol. 46(5), pp. 843–851.
- J. Shen** (2010). Robust Non-Zenoness of Piecewise Analytic Systems with Applications to Complementarity Systems. *Proceedings of the 2010 American Control Conference*, pp. 148–153, Baltimore, MD.
- J. Shen**, L. Han, and J.S. Pang (2010). Switching and Stability Properties of Conewise Linear Systems. *ESAIM: Control, Optimisation, and Calculus of Variations*, Vol. 16, pp. 764–793.
- J. Shen** and J. Hu (2010). Stability of Switched Linear Systems on Cones: A Generating Function Approach. *Proceedings of the 49th IEEE Conference Decision and Control*, pp. 420–425, Atlanta, GA.
- J. Shen** and J. Hu (2010). Stability of Discrete-time Conewise Linear Inclusions and Switched Linear Systems. *Proceedings of the 2010 American Control Conference*, pp. 4034–4039, Baltimore, MD.
- J. Shen** and X. Wang (2010). Estimation of Shape Constrained Functions in Dynamical Systems and its Application to Genetic Networks. *Proceedings of the 2010 American Control Conference*, pp. 5948–5953, Baltimore, MD.
- X. Wang and **J. Shen** (2010). A Class of Grouped Brunk Estimators and Penalized Spline Estimators for Monotone Regression. *Biometrika*, Vol. 97(3), pp. 585–601.
- A.M. Soane, **M. Suri**, and **R. Rostamian** (2010). The optimal convergence rate of a  $C^1$  finite element method for non-smooth domains. *Journal of Computational and Applied Mathematics*, 233, 2711-2723.
- M.S. Didolkar, C.W. Coleman, M.J. Brenner, K.U. Chu, N. Olexa, **E. Stanwyck**, A. Yu, **N.K. Neerchal**, and S. Rabinowitz (2010). Image-Guided Stereotactic Radiosurgery for Locally Advanced Pancreatic Adenocarcinoma Results of First 85 Patients. *Journal of Gastrointestinal Surgery*, 14 (10), 1547-1559.
- S. Thompson** (2010). An Extension of Browder's Non-Ejective Fixed Point Theorem. *Fixed Point Theory*, 11, 143-146.
- N. Petra**, A.A Kosterev, **J. Zweck**, **S.E. Minkoff**, and J.H. Doty, III (2010). Numerical and Experimental Investigation for a Resonant Optoacoustic Sensor. *Conference on Lasers and Electro-Optics*, Optical Society of America, p. CMJ6.

