

## **KHALID BOUSHABA**

Assistant Professor

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### **Education**

**2001:** Ph.D in Applied Math at University of Semlalia Marrakech Morocco and Centre de Recherche d'Ile de France (IRD).

Thesis: **Mathematical modeling of oceanic plankton.**

Advisors: Ovide Arino (Professor, Centre de Recherche d'Ile de France (IRD)

and

Mohamed Khaladi (Professor, University of Semlalia Marrakech.)

### **Awards/Fellowships**

- Moroccan Fellowship for Outstanding Graduate Students (1995 through 2001)
- IRD Fellowship, France (2000-2001).
- Postdoctoral Fellowship at the Department of Ecology and Evolutionary Biology University of Michigan (2001-2003)

### **Professional experience**

- Research Assistant at University of Pau, France (1996-1999)  
Engaged in an European Research Project on fisheries. Project number: DG XIV 96/048.
- Research Assistant at IRD, France (2000-2001)
- Research Fellow at University of Michigan (2001-2003)
- Assistant Professor at Iowa State University (2003-present)
- Long term visitor of Institute for Mathematics and Its Applications University of Minnesota. 1/4/08-6/30/08

### **Professional society**

- Society for Mathematical Biology (SMB)
- Network MTBio: Modeling and Theory in the Biosciences (Germany)
- Network on modeling and control of ecological system, (CoReV) (France)

### **Research interests**

Mathematical Biology, Cancer modeling, Population Dynamics, Differential Equations and Partial Differential Equations.

### **Publications**

#### **A. Refereed research articles**

1. O.Arino, K.Boushaba and A. Boussouar, *Modelization of the role of currents and turbulence on the growth and dispersion of the marine phytoplankton*, *Compte. Rendu de l'Académie des Sciences Life Sciences* 323 (2000) 113-118.
2. O.Arino, K.Boushaba and A. Boussouar, *A mathematical model of the dynamics of the phytoplankton-nutrient system*, *Journal of Non linear Analysis and Application, Real World Applications* 1 (2000) 69-87.
3. K.Boushaba, S. Ruan, *Instability in diffusive ecological models with nonlocal delay effects*, *Journal of Math Appl. And Analysis* 258, (2001) 269-286.

4. K. Boushaba, O. Arino and A. Boussouar, *A mathematical model of phytoplankton*, Mathematical Models and Methods in Applied Science (M3AS) Vol 12. No 6 (2002) 871-901.
5. K. Boushaba, M. Pascual, *Dynamics of the 'echo' effect in a phytoplankton system with nitrogen fixation* Bulletin of Mathematical Biology **67** (2005), no. 3, 487-507.
6. J. P. Peters, K. Boushaba and M. Nilsen-Hamilton, *A mathematical model for fibroblast growth factor competition based on enzyme kinetics*, Mathematical Biosciences and Engineering, **2** (2005), no. 4, 789-810.
7. K. Boushaba, H. Levine and M. Nilsen-Hamilton, *A Mathematical Model for the regulation of Metastatic tumor dormancy based on enzyme kinetics*. Bulletin of Mathematical Biology **68** (2006), no. 7, 1495-1526.
8. F. Bekkal-Brikci, K. Boushaba and O. Arino, *Nonlinear Age Structured Model with cannibalism*, Discrete and Continuous Dynamical Systems-Series B **7** (2007), no. 2, 201-218.
9. K. Boushaba, *A multi layer method applied to a model of phytoplankton*, Networks and Heterogeneous Media **2** (2007), no. 1, 37-54.
10. F. Bekkal-Brikci, G. Chiorino and K. Boushaba, *G1/S transition and cell population dynamics*. Accepted in Networks and Heterogeneous Media (36 pages)

## B. Submitted paper

1. A Mathematical feasibility for the use of aptamers in chemotherapy and imaging. (with H. A. Levine and M. Nilsen-Hamilton) Proceedings of the National Academy of Sciences, under review  
Supplemental material for: A Mathematical feasibility for the use of aptamers in chemotherapy and imaging. (with H. A. Levine and M. Nilsen-Hamilton) Proceedings of the National Academy of Sciences, under review

## C. Preprints

1. Mathematical modeling of angiogenesis in living zebra fish embryos. (with J. Essner and H. Levine) In preparation
2. Mathematical modeling of endothelial tube formation. (with J. Essner and A. Matzavinos) In preparation.
3. Stochastic model for molecular spider. (with A. Matzavinos and A. Roitershtein) In preparation.
4. Mathematical Modeling of *Escherichia coli* AcrB multidrug efflux pump (with Ed Yu and Hans Weinberger) in preparation.
5. Toxic effect on a phytoplankton-zooplankton model with non local effect (J. Chattopadhyay ). Preprint
6. Instability in a scalar reaction diffusion equation with nonlocal delay, (with S. Ruan) Preprint
7. Escapes of Farmed Atlantic Salmon (with Jean-Sébastien Lauzon-Guay) Preprint
8. Impact of the mesoscale eddies on the dynamics of 'echo' effect in a phytoplankton system with nitrogen fixation (with M. Pascual & G.R. Flierl). Preprint

#### **D. Invited Lectures, Scientific visits and Conference talks**

1. July 13-31, 1998: The summer school on the Evolution equation and application, Ouagadougou, Burkina Faso (organized by CIMPA). Talk: Semi group and its application to population dynamics. (Travel and living expenses paid by organizer)
2. September 4-8, 1998: The first conference on Mathematical Ecology, , Alcala, Spain. Talk: Modeling and Mathematical Analysis of Phytoplankton-Ocean Interaction. (Travel and living expenses paid by organizer)
3. March 29 - April 2 1999: The spring school on the Fragmentation and delays in population dynamics, in CIRM, Marseille, France. (Travel and living expenses paid by organizer)
4. July 10, 1999: INRIA, Sophia Antipolis, France. Talk:” Modelization of the role of currents and turbulence on the growth and dispersion of the marine phytoplankton” (Travel and living expense paid by INRIA)
5. July 26-30, 1999: The international Conference on Functional Differential and Difference Equations, Lisboa, Portugal. Talk: A Multilayer model of phytoplankton. (Travel and living expenses paid by organizer)
6. December 14-25, 1999: Department of Mathematics University of Katowice, Katowice Poland (Work with R. Rudinski on using stochastic modeling for phytoplankton.) Talk: “Mathematical model of phytoplankton system” (Travel and living expenses paid by a French/Poland cooperation grant).
7. January 15, 2000: Department of Mathematics, University of Semlalia Markech Morocco. Talk: “Mathematical modeling of the oceanic phytoplankton” (Travel and living expenses paid by Department of Mathematics University of Marrakech)
8. 28 February - 24 March 2000: ICTP, Trieste, Italy. Talk: “Population modeling of phytoplankton” and attend the FIFTH Course on Mathematical Ecology, including an Introduction to Ecological Economics. (Travel paid by University of Pau and living expenses paid by ICTP).
9. 9-12 May 2000: The spring Meeting of the Network on modeling and control of ecological system, dynamics, (Grignon, France). (Travel and living expenses paid by organizer)
10. September 4-15, 2000: Spatial Structures in Biology and Ecology: Models and Methods (ESMTB) Martina Franca (Taranto, Italy). Talk : “A multilayer method applied to a model of phytoplankton”. (Travel and living expenses paid by organizer)
11. December 19-22, 2000: Department of Mathematics, University of Alcala, Alcala Spain (Discuss with Rafa Bravo about phytoplankton modeling) (Travel and living expenses paid by University of Alcala)
12. March 15, 2001: IRD, Bondy, France. Talk:” Nonlinear age structured model with cannibalism”.
13. May 16-19, 2001: Department of Ecology and Evolution Biology, University of Michigan. Talk: “Modeling Nitrogen fixation for phytoplankton system”. (Travel and living expenses paid by University of Michigan)

14. May 28 - June 1, 2001: The spring Meeting of the Network on modeling and control of ecological system, dynamics, (La Londe les Maures, France). Talk: "Nonlinear age structured model with cannibalism". (Travel and living expenses paid by organizer)
15. June 11-22, 2001: Participated to the summer school: Biology and Mathematics of Cells: Physiology, Kinetics and Evolution. Sigüenza, Spain. (Travel and living expenses paid by IRD France)
16. December 10-14, 2001: Isaac Newton Institute, Cambridge, UK. Participated to the workshop: MACROSCOPIC ORGANISATION FROM MICROSCOPIC BEHAVIOUR IN IMMUNOLOGY, ECOLOGY AND EPIDEMIOLOGY.

(Travel paid by University of Michigan and living expenses paid by Isaac Newton Institute).

17. May 19-26, 2002: Department of Earth, Atmospheric and Planetary Sciences MIT, Cambridge MA. (Work with G. Flierl on coupling eddies with a phytoplankton model)
18. 2002 Annual Meeting of the Society for Mathematical Biology, Knoxville TN Poster presentation: "Dynamics of the 'echo' bloom in a plankton system with nitrogen fixation". (Travel paid by University of Michigan and living expenses paid by organizer)
19. February 3, 2003. Department of Mathematics, University of Michigan, Talk: "A Mathematical Model for Phytoplankton"
20. June 2-13, 2003: Department of Mathematics, University of Utah, Salt Lake city, Utah (Participated to VIGRE Minicourse on Biological invasion) (Travel and living expenses paid by University of Michigan)
21. September 5-9, 2003: The second conference on Mathematical Ecology, Alcala, Spain. Talk: "Impact of the mesoscale eddies on the dynamics of 'echo' effect in a phytoplankton system with nitrogen fixation" (with M. Pascual & G.R. Flierl) (Travel and living expenses paid by University of Michigan)
22. November 10-19, 2003: Mathematical Bioscience Institute (MBI) at Ohio State University (Participated to Mathematical Models of Cell Proliferation and Cancer Chemotherapy) (Travel and living expenses paid by MBI)
23. June 21-25, 2004: Computational and Mathematical Population Dynamics Joint conference MPD7-Destobio 3, Trento, Italy. Talk: "A Mathematical model for Metastasis" (Expense paid by Iowa State University)
24. January 7-10, 2005: Workshop on Spatial Ecology: The Interplay between Theory and Data, University of Miami, FL. Talk: "The interplay between eddies and a phytoplankton system with nitrogen fixation" (Travel and Hotel paid by organizers and living expenses by Iowa State University)
25. March 28-April 1 2005: The First Young Researchers Workshop in Mathematical Biology, Mathematical Bioscience Institute (MBI) at Ohio State University. Talk: "Mathematical modeling for tumor dormancy" (Travel and living expenses paid by MBI)
26. 9 - 13 May, 2005: Workshop on Dynamics of Cancer: Modeling and Experiment, University of Michigan, Ann Arbor, MI. Talk: "Two compartment model for the regulation of Metastatic tumor dormancy based on enzyme kinetics" (Travel and living expenses paid by organizers)
27. March 27 - 30, 2006: The Second Young Researchers Workshop in Mathematical Biology, Mathematical Bioscience Institute (MBI) at Ohio State University. Talk: "A Mathematical feasibility for the use of aptamers in chemotherapy"

28. April 14, 2006: Department of Mathematics, Arizona State University, Arizona State University. ““A Mathematical modeling for tumor dormancy” (Travel and living expenses paid by Arizona State University)
29. May 8-12, 2006: Workshop on angiogenesis, neovascularization and morphogenesis, IPAM UCLA, Los Angeles CA. Talk: “Cell signaling, endothelial migration, and zebra fish: a simplified model for angiogenesis”. (Travel and living expenses paid by IPAM)
30. September 9-12, 2006: SIAM conference on nonlinear waves and coherent structures, University of Washington, Seattle, WA. Talk:” Mathematical modeling for tumor metastases”. (Travel and living expenses paid by Iowa State University)
31. March 23-25, 2007: Opportunities in Mathematical Biology for Under- represented groups workshop, Mathematical Bioscience Institute (MBI) at Ohio State University. (Travel and living expenses paid by MBI)
32. March 24-26, 2008: invited speaker to the Mathematical Bioscience Institute (MBI) at Ohio State University. “Mathematical modeling of angiogenesis in living zebra fish embryos” (Travel and living expenses paid by MBI)
33. July 2-4, 2008: invited speaker to the Workshop on Growth and Control of Tumors: Theory and Experiment at Field Institute, Toronto : “A mathematical model for cell signaling and endothelial migration in a living zebra fish embryos” (Travel and living expenses paid by Field Institute)
34. October 24-26, 2008: invited speaker to AMS Southeastern meeting at University of Alabama, Huntsville, AL : “A mathematical model of angiogenesis in a living zebra fish embryos”

## Teaching

### Undergraduate:

Year	Semester	Courses Taught
2004	Spring	M267 Elementary Differential Equations and Laplace Transforms. (2 sections)
2004	Fall	M267 Elementary Differential Equations and Laplace Transforms.(2 sections)
2005	Spring	M385 Introduction to Partial Differential Equations
2005	Fall	M385 Introduction to Partial Differential Equations
2005	Fall	M307 Matrices and Linear Algebra
2006	Spring	M385 Introduction to Partial Differential Equations
2006	Fall	M266 Elementary Differential Equations.
2007	Fall	M267 Elementary Differential Equations and Laplace Transforms. (2 sections)
2008	Fall	M385 Introduction to Partial Differential Equations

### Graduate:

2006	Fall	M557 Ordinary Differential Equations I
2007	Spring	M654 Ordinary Differential Equations II

### **Research Experience for Undergraduates:**

I was a participating faculty member in National Science Foundation –REU.  
Please see [www.math.iastate.edu/reu/homepage.html](http://www.math.iastate.edu/reu/homepage.html) for details of some of our projects.  
I was advising two undergraduates student: Rahul Bonsal and Justin Peters. Summer 2005, Summer 2006 I was advising two undergraduates student: Andrew Matteson and Shilian Chen.

### **Master’s Committee or Creative Component Supervisor**

Ahmet Tlturk (MA with thesis)  
Major Professor: Prof. Fritz Keinert  
Thesis: *Matrix Wavelets*

### **Ph.D POS Committee or Thesis Supervisor**

Ghanshyam Bhatt (Ph.D -2004)  
Major Professor: Prof. Fritz Keinert  
Dissertation: Non separable multivariable wavelets  
Rajeev Rajaram (Ph.D 2005)  
Major Professor: Prof Scott Hansen  
Dissertation: Controllability of three layer sandwich  
Tauquir Bibi (PhD candidate education)  
Major Professor: Gary D. Phye  
Cory Howk, PhD candidate  
Major Professor: Prof Howard Levine  
Yeon-Jung Seo (PhD candidate)  
Major Professor: Prof Howard Levine

## **Professional service**

### **A. Panel Invitation**

**2006**

I was invited to server as reviewer for the Scientific Discovery through Advance Computing (SciDAC) program of DOE’s Office of Science (US Department of Energy)

### **B. Refereeing Papers for:**

The count starts from 2003

#### **Research Journals:**

- Journal of Discrete and Continuous Dynamical System-B (2 papers)
- Ecological modeling journal (4 papers)
- Journal of Mathematical Methods in the Applied Sciences (2 paper)
- Bioinformatics journal (1 paper)
- British cancer journal ( 1 paper)
- IEE System Biology journal (1 paper )
- Journal of Biological Chemistry (1 paper)
- SIAM Applied Math (1 paper )
- Journal of Theoretical Biology (1 paper)
- The Open Bioinformatics journal (1 paper)

### **Mathematical reviews**

- Mathematical Reviews (5 papers)

### **C. Department service:**

- Co-Chair for the ISU Math. Department Colloquium
- Applied Math Qualifying Examination Committee
- Search Committee
- Representing the ISU Math Department at the Institute of Mathematical and its Application (IMA) annual Board Meeting (June 11 2008)

### **D. Conference organization:**

Marrakesh International Conference and Workshop on Mathematical Biology, Marrakesh, January, 3-8, 2008. Co-Chair of the organizing committee.

### **Grant activities**

- An interdisciplinary Approach to Understanding Endothelial Tube Formation.  
PIs: J. Essner, **K. Boushaba**, A. Matzavinos. This proposal was submitted to NIH, 2008 (pending) Amount requested: \$1.25 million direct cost over 5 years.
- Breaching the Blood Brain Barrier to Selectively Deliver Chemotherapeutic Agents  
PIs: M. Nilsen-Hamilton, **K. Boushaba**, H A. Levine, and G. A. Kraus.  
**this pre proposal was selected by a university-wide committee** to be developed into a full proposal for the James S. McDonnell Foundation 21st Century Science Initiative Research Award in the Brain Cancer Research program area. 2008 (not funded)
- Institute for Mathematics and its Application, University of Minnesota, award for project: Participant cost in Program Mathematics of Molecular and Cellular Biology. (PI: **K. Boushaba**) \$20700. (Jan 2-June 30 2008)
- NSF: DMS-0756669 (PI: **K. Boushaba**) \$20000 Support for Marrakesh International Conference and Workshop on Mathematical Biology, Marrakesh, January, 3-8, 2008
- International Union of Mathematics: \$2500 travel fund for 08 Marrakech conference
- Society for Mathematical Biology: \$2000 travel fund for 08 Marrakech conference
- ANTIOX, Fusion Nanomedicine Employing Aptamers and Nanoparticles to Target Intracellular Organelles with Antioxidants PIs: Marit Nilsen-Hamilton, Victor Lin, George Kraus, Anumantha Kanthasamy, Howard Levine, **Khalid Boushaba** and Jim Oliver. This proposal to Keck Foundation. 2008 (not funded) \$2.06 Millions over 2 Year
- Mathematical modeling of angiogenesis in living zebra fish embryos.  
This proposal was submitted to NSF math biology section.  
(PI: K. Boushaba, Co-PI: Jeff Essner, amount requested is \$334,347 over 3 years. 2007 (not funded).

- Mathematical modeling of inflammation. This proposal was submitted to NIH as R21 cluster proposal (multi PI's: H.A. Levine and K.Boushaba for the math part, M.Nilsen-Hamilton and M. Ackerman for the biology part, amount requested for the math part is \$333,258 over 3years. 2007 (not funded)
- Mathematical modeling of angiogenesis in Zebrafish (in collaboration with Jeff Essner) (Proposal submitted to ISU internal seed money Research Grant Development Awards for New Faculty) (not funded)
- Tissue Morphogenesis: Integration of Mathematical modeling with biological experiments. 21st Century Research Awards at James McDonnell Foundation. PI: **K.Boushaba**, Co-PI: M. Nilsen-Hamilton. Amount requested: \$449,998 over 5 years. (not Funded)