

Sébastien Benzekry

French
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Situation

2013 - Research Scientist (CR1) at Inria Bordeaux, team MONC
Grant bonus for doctoral management and research achievements (PEDR)

Formation

2012 Postdoctoral fellow in mathematical modeling of cancer from January 2012 until November 2012 at the Center of **Cancer and Systems Biology** at Tufts University, School of Medicine, Boston, under the supervision of Philip Hahnfeldt

2008 - 2011 **Doctorate of applied mathematics**
LATP and Laboratoire de Pharmacocinétique et Toxicocinétique, Marseille

Title **Modeling, mathematical and numerical analysis of anti-cancerous therapies for metastatic cancers**

2008 Laureate of the **Agregation of mathematics**, option Scientific calculus (rank 105).

2007 - 2009 Student at the Ecole Normale Supérieure of Cachan, 3rd year entrance concourse.

2004 - 2007 Mathematics magister at the Ecole Normale Supérieure of Paris. Mention Good.

2006 - 2007 Master 2 **Mathematics of modeling** at the University Pierre et Marie Curie, Paris, specialty biology. Mention Good.

Master 2 internship at the mathematics department of the UPC in **Barcelone** :
Exploration of deterministic and stochastic neuron networks

2004 - 2006 Bachelor and Master 1 degrees of Mathematics, ENS Paris.

Research interests

My research is focused on applied mathematics to cancer research. Some topics of my research include

- Data-based modeling of the metastatic development and tumor-tumor interactions
- Scheduling optimization for anti-cancerous therapies. Pharmacokinetics/Pharmacodynamics modeling in oncology

*International journals***Mathematical modeling of tumor-tumor inhibition supports a systemic control of tumor growth**

S. Benzekry, C. Lamont, D. Barbolosi, L. Hlatky, P. Hahnfeldt
Cancer Research, in press, (2017)

Non-Standard Radiotherapy Fractionations Delay the Time to Malignant Transformation of Low-Grade Gliomas

A. Henares-Molina, S. Benzekry, P.C. Lara, M. Garcia-Rojo, V.M. Perez-Garcia and A. Martinez-Gonzalez
PloS One, in press, (2017)

Model Driven Optimization of Antiangiogenics + Cytotoxics Combination : Application to Breast Cancer Mice Treated with Bevacizumab + Paclitaxel Doublet Leads to Reduced Tumor Growth and Fewer Metastasis

S. Mollard, J. Ciccolini, D.C. Imbs, R. El Cheikh, D. Barbolosi, S. Benzekry
Oncotarget, Volume 5, 10.18632/oncotarget.15484, (2017)

In vivo bioluminescence tomography for monitoring breast tumor growth and metastatic spreading : comparative study and mathematical modeling

S. Mollard, R. Fanciullino, S. Giacometti, C. Serdjebi, S. Benzekry, Joseph Ciccolini
Scientific reports, Volume 6, 36173, (2016)

Mathematical modeling of cancer immunotherapy and synergy with radiotherapy

R. Serre, S. Benzekry, L. Padovani, C. Meille, N. André, J. Ciccolini, F. Barlési, X. Muracciole, and D. Barbolosi
Cancer Research, 76(17), 4931-40, (2016)

Modeling spontaneous metastasis following surgery : An In vivo/ in silico approach

S. Benzekry, A. Tracz, M. Matri, R. Corbelli, D. Barbolosi, J.M.L. Ebos
Cancer Research, 76(3), 535-547, (2016)

Computational modelling of metastasis development in renal cell carcinoma

E. Baratchart, S. Benzekry*, A. Bikfalvi*, T. Colin*, L.S. Cooley, R. Pineau, E. Ribot, O. Saut, W. Souleyreau
PloS Computational Biology, 11(11), e1004626, (2015)

Metronomics reloaded : theoretical models bringing chemotherapy into the era of precision medicine

S. Benzekry⁺, E. Pasquier⁺, D. Barbolosi, B. Lacarelle, F. Barlesi, N. Andre and J. Ciccolini
Seminars in Cancer Biology, 35, 53-61 (2015)

Improving efficacy of the combination between antiangiogenic and chemotherapy : Time for mathematical modeling support

J. Ciccolini, S. Benzekry, B. Lacarelle, D. Barbolosi and F. Barlési
Proceedings of the National Academy of Sciences USA, 112(27), E3453, (2015)

Design Principles for Cancer Therapy guided by changes in complexity of Protein-Protein Interaction Networks

S. Benzekry , J.A. Tuszynski, E.A. Rietman, G.L. Klement
Biology Direct, 10 (32), (2015)

Host Age is a Systemic Regulator of Gene Expression Impacting Cancer Progression

A. Beheshti, S. Benzekry, J.T. MacDonald, L. Ma, M. Peluso, P. Hahnfeldt, L. Hlatky

Cancer Research, 75 (6), 1134-43, (2015)

Classical Mathematical Models for Description and Forecast of Preclinical Tumor Growth

S. Benzekry, C. Lamont, A. Beheshti, A. Tracz, J.M.L. Ebos, L. Hlatky, P. Hahnfeldt

PloS Computational Biology, 10(8), e1003800, (2014)

Global dormancy of metastases due to systemic inhibition of angiogenesis

S. Benzekry, A. Gandolfi, P. Hahnfeldt

PloS One, 9(1), e84249 (2014)

Maximum tolerated dose versus metronomic scheduling in the treatment of metastatic cancers

S. Benzekry, P. Hahnfeldt

Journal of Theoretical Biology, 335, 235-244, (2013)

Theoretical investigation of the efficacy of antiangiogenic drugs combined to chemotherapy in xenografted mice

F. Lignet , **S. Benzekry**, S. Wilson, F. Billy, O. Saut, M. Tod, B. You, A. Adda Berkane, S. Kassour, M.X. Wei, E. Grenier, B. Ribba

Journal of Theoretical Biology, 320, 86-99, (2013)

Modeling the impact of anticancer agents on metastatic spreading

S. Benzekry, N. André, A. Benabdallah, J. Ciccolini, C. Faivre, F. Hubert, D. Barbolosi

Mathematical Modeling of Natural Phenomena, 7 (1), 306-336, (2012)

A new mathematical model for optimizing the combination between antiangiogenic and cytotoxic drugs in oncology

S. Benzekry, G. Chapuisat, J. Ciccolini, A. Erlinger, F. Hubert

Comptes Rendus de l'Académie des Sciences - Mathématiques, 350, 23-28, (2012)

Mathematical and numerical analysis of a model for anti-angiogenic therapy in metastatic cancers.

S. Benzekry

M2AN, 46 (2), 207-237, (2012)

Passing to the limit 2D-1D in a model for metastatic growth

S. Benzekry

Journal of Biological Dynamics, doi :10.1080/17513758.2011.568071, (2011)

Mathematical analysis of a two-dimensional population model of metastatic growth including angiogenesis

S. Benzekry

Journal of Evolution Equations, 11 (1), 187-213, (2011)

Book chapters

Les lois de la croissance tumorale S. Benzekry

Bibliothèque Tangente, Hors-série Maths et Médecine, (2016)

A Mathematical Model for Growing Metastases on Oncologists's Service

D. Barbolosi, A. Benabdallah, **S. Benzekry**, J. Ciccolini, C. Faivre, F. Hubert, F. Verga, B. You

In Computational Surgery and Dual Training, Springer New York, 331-338, (2014)

Proceedings and protocols

On the growth and dissemination laws in a mathematical model of metastatic growth

S. Benzekry, J. ML Ebos

ITM Web of Conferences, 5, (2015)

Capturing the Driving Role of Tumor-Host Crosstalk in a Dynamical Model of Tumor Growth

S. Benzekry, A. Beheshti, P. Hahnfeldt, L. Hlatky
bio-protocol, 5(21), e1644, (2015)

Model-based optimization of combined antiangiogenic + cytotoxics modalities : application to the bevacizumab-paclitaxel association in breast cancer models

S. Mollard, **S. Benzekry** , S. Giacometti, C. Faivre, F. Hubert, J. Ciccolini, and D. Barbolosi
Cancer Research, In : Proceedings of the 105th Annual Meeting of the American Association for Cancer Research, 74, (2014)

A mathematical model of systemic inhibition of angiogenesis in metastatic development

S. Benzekry, A. Gandolfi and P. Hahnfeldt
ESAIM : Proceedings, 45, 75-87, (2014)

International conferences (invited)

- December 2017 Mathematical Methods and Modeling of Biophysical Phenomena, Rio de Janeiro, Brazil
- May 2016 Metronomics @ Mumbai, Mumbai, India
- December 2015 Present challenges of mathematics in oncology and biology of cancer, Marseille, France.
- November 2015 Dynamique et contrôle des croissances tumorales, Rouen, France.
- November 2015 Contrôle des EDP et applications , Marseille, France.
- October 2015 Journées du Groupe de Métabolisme et Pharmacocinétique , Paris, France.
- June 2015 Micro and Macro Systems in Life Sciences (MMSLS 2015), Bedlewo, Poland
- March 2015 Workshop on hybrid and multiscale modelling in cell and cell population biology , Laboratoire Jacques-Louis Lions, Paris, France. *Combined in vivo and in silico quantitative modeling of post-surgery metastatic development*
- March 2015 Mathematical Methods and Modeling of Biophysical Phenomena, Cabo Frio, RJ, Brazil. *A modeling study of metastatic initiation and tumor-tumor spatial interactions*
- January 2015 36th EORTC PAMM Winter meeting , Marseille, France. *A translational in vivo/in silico quantitative modeling study of the impact of surgery on metastatic relapse and survival in breast cancer*
- October 2014 Autumn School by Japanese and French Mathematicians , Osaka, Japan. *Mathematical modeling of tumor growth and metastatic spread. Data, theories and predictions.*
- July 2014 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications , Madrid, Spain. *A mathematical model of systemic inhibition of angiogenesis in metastatic development*
- November 2013 French-Mexican Meeting on Industrial and Applied Mathematics, Villahermosa, México. *Classical Mathematical Models for Description and Forecast of Preclinical Tumor Growth*
- May 2013 Bi-annual congress of the SMAI, Seignosse, France. *Mathematical modeling of systemic inhibition of angiogenesis and metastatic dynamics*
- March 2013 Workshop on Mathematical Methods and Modeling of Biophysical Phenomena, Cabo Frio, Brazil. *Mathematical modeling of systemic inhibition of angiogenesis and metastatic dynamics*
- July 2012 2nd Annual Workshop on Cancer Systems Biology - Tumor Metronomics : Timing and Dose Level Dynamics, Center for Cancer and Systems Biology, Boston, USA. *Mathematical modeling of metastatic development and scheduling optimization of anti-cancerous therapies*
- July 2011 7th International Congress of Applied and Industrial Mathematics (ICIAM 2011), Vancouver. *Mathematical modeling of the metastatic process and optimization of anti-cancerous therapies*, in the session Tumor growth modeling and system identification for clinical applications
- July 2011 Workshop on Systems Biology of Tumor Dormancy. St. Elizabeth's Medical Center, Boston, USA. *A modeling approach for therapies in metastatic cancers*
- May 2011 Journée Emergence de l'Institut Gustave Roussy (IGR), Paris. *Un exemple de modélisation du processus métastatique*

- May 2010 2nd Workshop on Metronomic Anti-Angiogenic Chemotherapy in Paediatric Oncology, Marseille. *Mathematical modeling of MTD and metronomic temozolomide*
- May 2010 8th conference of the American Institute of Mathematical Sciences (AIMS), Dresde. *Modeling and mathematical analysis of metastatic growth under angiogenic control*, in the session Evolution equations and mathematical biology

Accepted communications

- March 2017 38th EORTC-PAMM Winter meeting, Split, Croatia. *Optimization of the timing of sequential administration of bevacizumab plus cytotoxics in NSCLC by a mathematical model*. (Oral communication)
- October 2015 Journées du canceropôle Grand Sud-Ouest , Bordeaux, France. *Modeling spontaneous metastasis following surgery : an in vivo-in silico approach* (Poster)
- June 2015 Mathematical Methods in Systems Biology, Dublin, Ireland. (Oral communication)
- June 2014 European Conference on Mathematical and Theoretical Biology, Göteborg, Sweden. *Metastatic dynamics, systemic inhibition of angiogenesis and implications for surgery* (Oral communication)
- June 2014 International Tumor Dormancy Symposium , Lille, France. *Metastatic dynamics and systemic inhibition of angiogenesis. Implications for dormancy and surgery* (Poster)
- October 2011 Journées du Groupe de Métabolisme et Pharmacocinétique. Paris. *Biomathematical modeling for description of metastatic processes and optimization of combined anti-angiogenic + cytotoxic therapies* (Poster and oral communication)
- June 2011 8th European Conference of Mathematical and Theoretical Biology, Krakow. *Optimal schedules for therapies in metastatic cancers*
- June 2010 CANUM 2010, Gironde. *A model of metastatic growth under angiogenic control*
- May 2010 CMPD 3, Bordeaux. *A model of metastatic growth under angiogenic control*
- November 2009 Conference of biomathématiques et biomechanics, Tozeur, Tunisie. Poster *Analysis and modeling of metastatic growth including angiogenesis*

Seminars

- May 2017 Laboratoire d'Analyse Topologie et Probabilites, Institut de Mathematiques de Marseille. *Mathematical Oncology : Theory Meets Reality*. Marseille, France.
- November 2016 Integrated Mathematical Oncology Department, Moffitt Cancer Center. *Mathematical Modeling of Metastasis : Theory Meets Reality*. Tampa, Florida, USA.
- October 2016 Department of Genetics, Roswell Park Cancer Institute (invitation by John ML Ebos). *Mathematical Modeling of Metastasis : Theory Meets Reality*. Buffalo, NY, USA.
- October 2016 Robert Kerbel's laboratory at Sunnybrook Research Institute. *Mathematical Modeling of Metastasis : Theory Meets Reality*. Toronto, Canada.
- October 2016 Mathematics Department Colloquium, Ryerson University. *Mathematical Modeling of Metastasis : Predicting the invisible*. Toronto, Canada.
- May 2016 Seminar at the laboratory of Génétique, Immunothérapie, Chimie et Cancer" of the University of Tours, Tours, France. *Data-based mathematical modeling analysis of preclinical studies in oncology*
- January 2016 Seminar at the laboratoire d'imagerie biomédicale, Paris, France. *Classical Mathematical Models for Description and Prediction of Experimental Tumor Growth*
- May 2015 Biomathematics Seminar, University of Gothenburg, Sweden *Modeling spontaneous metastasis following surgery : An In vivo/ in silico approach*
- March 2014 Seminar of the inria team Dracula, Lyon, France. *Classical Mathematical Models for Description and Prediction of Experimental Tumor Growth*
- April 2013 ANEDP team, Orsay, France. *Mathematical modeling of systemic inhibition of angiogenesis and metastatic dynamics*
- February 2013 LATP, Marseille. *A math walk in a biology lab*
- December 2011 Team MC2, Bordeaux. *Modeling, mathematical and numerical analysis of anti-cancerous therapies*
- Novembee 2011 EDP Seminar of the Mathematics department, Besançon. *Modeling, mathematical and numerical analysis of anti-cancerous therapies*
- Mai 2010 Math-Bio seminar Maths-Bio of the university Lyon 1. *Modeling and mathematical analysis of metastatic growth under angiogenic control*
- October 2009 Maths-Cancer working group, School of Pharmacy, Marseille. *Modeling of angiogenesis*
- June 2009 Bucolic days of the doctoral seminar, LATP, Marseille

Foreign research visits

- Fall 2016 Short sabbatical at the **Roswell Park Cancer Institute** (J. Ebos' lab), Buffalo, NY, USA
Stay at the **Integrated Mathematical Oncology** department of the Moffitt Cancer Center, Tampa, FL, USA
- September 2015 **Mathematical Oncology Laboratory (Môlab)**, Ciudad Real, Spain. Collaboration with V. Pérez-Garcia and A. Martinez-González
- May 2011 Istituto di Analisi dei Sistemi ed Informatica "Antonio Ruberti", Consiglio Nazionale delle Ricerche, Rome. Collaboration with A. Gandolfi et A. d'Onofrio

PhD students

- 2016 - 2019 Chiara Nicolò : “Mathematical modeling of systemic aspects of cancer and cancer therapy” (co-supervision with O. Saut)
- 2013 - 2015 Etienne Baratchart : “Quantitative study of the metastatic process using mathematical modeling” (co-supervision with T. Colin and O. Saut)

Master 2 internships

- 2017 M. Bilous (Ecole Polytechnique, M2 of biomechanical engineering) : “Mathematical modeling and prediction of clinical brain metastases in non-small cell lung cancer”
- 2014 Aristoteles Camilo (IMPA, Rio de Janeiro, Brazil and University Pierre et Marie Curie, Paris, France) : “ An experimentally-based modeling study of the effect of anti-angiogenic therapies on primary tumor kinetics for data analysis of clinically relevant animal models of metastasis”

Other internships

- 2016 Laura Lumale (INSA engineering school, 2nd year (M1)) : “Around a mathematical model of the concomitant tumor resistance phenomenon”
- 2015 Simon Evain (“Ponts et Chaussées” engineering school, 2nd year (M1)) : “Mathematical modeling of tumor and metastatic growth when treated with sunitinib”
- 2015 Maxime Prodhomme (ENS Cachan, 1st year (L3))

Teaching

- 2015 - 2017 Teaching assistant for ordinary differential equations in the first year of engineering school Matmeca, Bordeaux, France
- 2014 - 2017 Supervision of various projects in applied mathematics in Matmeca (L3) or University of Bordeaux (L3 and M1), Bordeaux, France
- 2009 - 2011 Teaching duties in mathematics (analysis, topology and differential calculus, numerical analysis, preparation to the agregation), 192 hours, University of Aix-Marseille, France.

Scientific community activities

Reviewer for grant applications submitted to : the Austrian Science Fund, the Centre d'Excellence Africain en Technologies de l'Information et de la Communication and the TEAM program (European Union and Foundation for Polish Science).

Invited editor of a special issue for the journal Complexity : “Mathematical Oncology : Unveiling Biological Complexity Using Mathematical Methods”

Reviewer for several international journals including **modeling journals** (Journal of Theoretical Biology, Bulletin of Mathematical Biology, PloS One, Mathematical Biosciences, Theoretical Biology and Medical Modeling, Mathematical Biosciences and Engineering, Journal of Biological Informatics, Journal of Biological Systems, ESAIM :Proc, Mathematics and Computers in Simulation) and **biological/medical journals about cancer and pharmacokinetics** (British Journal of Cancer, Clinical Pharmacokinetics, BMC Cancer, Breast Cancer Research and Treatment).

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| June 2018 | Member of the organizing committee of the 3rd Thematic school ”Present challenges of mathematics in oncology and biology of cancer : modeling and mathematical analysis” |
| July 2015 | Member of the scientific committee of the MB2 conference (Bio-mathematics modeling days of Besançon) |
| March 2012 | Member of the organizing committee of the 2nd Thematic school ”Present challenges of mathematics in oncology and biology of cancer : modeling and mathematical analysis” |