

# R. J. Seager

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## EDUCATION

*Ph.D.*, Biomedical Engineering, November 2019  
Thesis: Toward a quantitative understanding of cancer cell signaling: mathematical models, computational tools, applications, and beyond  
Advisor: Muhammad H. Zaman, Ph.D.  
Boston University, Boston, Massachusetts

*M.S.*, Biomedical Engineering  
Boston University, Boston, Massachusetts, May 2018

*B.S.*, Nuclear Engineering  
Minor: Mathematics  
Texas A&M University, College Station, Texas, May 2014; Summa Cum Laude

Advanced Regents Diploma with Honors  
Wilson High School, Wilson, NY, June 2010; Valedictorian

## RESEARCH INTERESTS

I am interested in the multiscale interactions between the many biological, chemical, and mechanical actors in the tumor microenvironment, including tumor cells, immune cells, non-cancerous stromal cells and the extracellular matrix. None of these actors exist in a vacuum, and thus the interactions between these groups are an important determinant of gross tumor behavior. In particular, I study how the interplay between these actors affects tumor progression and patient treatment response, with a particular focus on tumor-immune interactions. To understand these interactions, I develop data-driven computational models and large-scale data analysis workflows, informed by laboratory analyses and cancer genomic and transcriptomic data, that allow the analysis of complex biological phenomena and furthermore, facilitate a deeper understanding of how these complex systems respond to various chemical and biological factors in the tumor microenvironment, including therapeutic interventions such as immunotherapeutic drugs. Through the careful interpretation and application of the results of these analyses, predictive models and biomarkers can be developed which facilitate a greater understanding of how tumors respond to microenvironmental changes, why some patients respond better to certain treatments than others, and how to best personalize treatment strategies to increase patient treatment response and promote long-term survival.

## EMPLOYMENT **OmniSeq, Inc. (Labcorp)**

Buffalo, NY

*Bioinformatics Scientist*

March 2020 - Present

- Assisted in development of bioinformatics platforms for genomic and immune profiling of solid tumors for precision treatment of cancer patients
- Analyzed large-scale tumor gene expression and mutation databases
- Developed biomarkers and gene signatures for the prediction of treatment outcomes for various cancer therapies
- Published 6 peer-reviewed articles and 6 conference presentations

### **Daemen University**

Buffalo, NY

*Adjunct Professor, Department of Business*

January 2022 - August 2022

- Taught MBA 511: Data-Driven Decision Making
- Instructed business students in leveraging real-world data to optimize decision-making
- Demonstrated and taught techniques in software including R, Python, and Excel

### **Texas A&M Center for Large-Scale Scientific Simulations**

College Station, TX

*Undergraduate Researcher*

April 2012 - May 2014

- Investigated new methods of neutron transport simulation in nuclear engineering
- Implemented, tested, and evaluated the strengths and weaknesses of the upstream corner balance family of computational particle transport methods

### **Texas A&M Nuclear Power Institute Systems Engineering Initiative**

College Station, TX

*Joint Nuclear Project Undergraduate Researcher*

January 2011 - May 2011

- Developed a computer model which determined the probability of a specific type of mechanical failure, resulting in a change in plant operating conditions
- Collaborated with industry professionals at South Texas Project Nuclear Operating Company.

### **Town of Wilson Summer Recreation Program**

Wilson, NY

*Counselor*

July 2008 - August 2012

- Supervised children at middle school and elementary recreation programs

## **RESEARCH**

### **Industrial Research**

*Biomarker Development*

- Identified biomarkers associated with treatment outcomes for cancer patients, including markers of tumor immunogenicity, cell proliferation, and antigen expression.
- Applied advanced data analysis techniques to large-scale clinical and next-generation DNA and RNA sequencing datasets
- Collaborated with clinical, academic, and pharmaceutical industry researchers

*Genomic and Immune Profiling Data Analysis*

- Profiled the distributions of clinically relevant factors, including potential treatment targets and markers of tumor immune escape, in both specific cancer type and pan-cancer contexts.
- Applied advanced data analysis techniques to large-scale clinical and next-generation DNA and RNA sequencing datasets.
- Collaborated with clinical, academic, and pharmaceutical industry researchers

## **Doctoral Research**

### *Data-driven modeling and analysis of TGF- $\beta$ signaling in cancer*

- Developed a Python-based computational model of mechanically modulated TGF- $\beta$  signaling in tumors
- Conducted detailed analysis of large experimental datasets, including gene expression and transcription factor binding arrays, to inform mathematical model and parameters
- Developed hypothetical pharmaceutical strategies to force tumor-suppressive TGF- $\beta$  signaling by cross-referencing signaling model with drug target data

### *Computational modeling of macrophage-induced signaling crosstalk in cancer*

- Developed a Python-based computational model of signaling underlying tumor cell migration behaviors in response to macrophage-secreted cytokines
- Informed and validated model from scientific literature and experimental cell migration data
- Predicted signaling proteins responsible for crosstalk between TGF- $\beta$  and TNF $\alpha$  signaling pathways

### *Computational modeling of cytokine-induced macrophage migration in tumors*

- Developed a Python-based computational model of signaling responsible for macrophage migration in response to tumor-secreted cytokines and interstitial flow
- Informed mathematical model from scientific literature and experimental cell migration data
- Predicted specific cytokines and signaling proteins responsible for experimentally observed migration behavior

### *Mathematical modeling of solid dissolution*

- Developed a partial differential equation model of the distribution of fragment volumes as a body fragments and dissolves in a liquid solvent
- Fit MATLAB implementation of model against experimental dissolution kinetics data
- Informed development of next generation portable pharmaceutical quality testing equipment

## **Undergraduate Research Thesis**

### *Implementing and testing upstream corner balance methods in PDT*

- Conducted long-term independent project at Texas A&M Center for Large-Scale Scientific Simulations in fulfillment of Undergraduate Research Scholars Program and Engineering Scholars Program requirements
- Investigated computational solutions to particle transport problems in nuclear engineering, which are often unsolvable with traditional or analytical methods
- Implemented, tested, and evaluated the strengths and weaknesses of the upstream corner balance family of computational particle transport methods

## **Texas A&M Nuclear Power Institute Systems Engineering Initiative Joint Research Project**

### *Probabilistic Failure Analysis of a Residual Heat Removal Heat Exchanger During a Postulated Loss of Coolant Accident*

- Developed a computer model which determined the probability of a specific type of mechanical failure, resulting in a change in plant operating conditions

- Collaborated with industry professionals at South Texas Project Nuclear Operating Company

## PUBLICATIONS

1. L. Nitsche, Y. Vedire, E. Kannisto, X. Wang, **R. J. Seager**, S. Pabla, S. K. Patnaik, and S. Yendamuri. Visceral Obesity in Non-Small Cell Lung Cancer. *Cancers*, 14 (14), 3450 (2022).
2. S. Mukherjee<sup>†</sup>, **R. J. Seager**<sup>†</sup>, Y. H. Lee, J. M. Conroy, P. Kalinski, and S. Pabla. Tumor inflammation, obesity, and proliferative status as biomarkers in gastroesophageal adenocarcinoma. *Journal of Personalized Medicine*, 11 (12), 1324 (2021).
3. J. M. Conroy, S. Pabla, S. T. Glenn, **R. J. Seager**, E. Van Roey, S. Gao, B. Burgher, J. Andreas, V. Giamo, and M. Mallon. A scalable high-throughput targeted next-generation sequencing assay for comprehensive genomic profiling of solid tumors. *PLoS One*, 16 (12), e0260089 (2021).
4. S. Pabla, **R. J. Seager**, E. Van Roey, S. Gao, C. Hoefer, M. K. Nesline, P. DePietro, B. Burgher, J. Andreas, V. Giamo, Y. Wang, F. L. Lenzo, M. Schoenborn, S. Zhang, R. Klein, S. T. Glenn, and Conroy, J. M. Integration of tumor inflammation, cell proliferation, and traditional biomarkers improves prediction of immunotherapy resistance and response. *Biomarker Research*, 9 (1), 1-11 (2021).
5. S. K. Patnaik, C. Petrucci, J. Barbi, **R. J. Seager**, S. Pabla, and S. Yendamuri. Obesity-specific association of statin use and reduced risk of recurrence of early-stage non-small cell lung cancer. *JTO Clinical and Research Reports*, 100254 (2021).
6. J. Barbi, S. K. Patnaik, S. Pabla, R. Zollo, R. J. Smith Jr, S. N. Sass, A. Srinivasan, C. Petrucci, **R. J. Seager**, and J. M. Conroy. Visceral Obesity Promotes Lung Cancer Progression Towards Resolution of the Obesity Paradox in Lung Cancer. *Journal of Thoracic Oncology*, 16 (8), 1333-1348 (2021).
7. S. Pabla, **R. J. Seager**, E. Van Roey, S. Gao, C. Hoefer, M. K. Nesline, P. DePietro, B. Burgher, J. Andreas, V. Giamo, Y. Wang, F. L. Lenzo, M. Schoenborn, S. Zhang, R. Klein, S. T. Glenn, and J. M. Conroy. Integration of tumor inflammation, cell proliferation, and traditional biomarkers improves prediction of immunotherapy resistance and response. *Biomarker Research*, 9:1, 1-11 (2021).
8. S. Mukherjee, **R. J. Seager**, Y. Lee, J. M. Conroy, and S. Pabla. Tumor inflammation and proliferative status as biomarkers in gastroesophageal adenocarcinoma. *Annals of Oncology*. 32, S204 (2021).
9. J. Barbi, S. K. Patnaik, S. Pabla, R. Zollo, R. J. Smith Jr., S. N. Sass, A. Srinivasan, C. Petrucci, **R. J. Seager**, J. M. Conroy, E. Kannisto, X. Wang, S. Shah, R. Gosain, K. Attwood, C. Roche, and S. Yendamuri. Visceral Obesity Promotes Lung Cancer Progression: Towards Resolution of the Obesity Paradox in Lung Cancer. *Journal of Thoracic Oncology* (2021).
10. **R. J. Seager**, E. Van Roey, S. Gao, J. Andreas, V. Giamo, B. Burgher, F. L. Lenzo, M. K. Nesline, P. DePietro, Y. Wang, S. T. Glenn, S. Zhang, J. M. Conroy, and S. Pabla. Cancer testis antigen co-expression landscape in solid tumors. *Journal for Immunotherapy of Cancer*. 8:Suppl 3 (2020).
11. Lee, S. W. L.<sup>†</sup>, **R. J. Seager**<sup>†</sup>, F. Litvak, F. Spill, J. L. Sieow, P. H. Leong, K. Dillip, A. Tan, S. C. Wong, G. Adriani, M. H. Zaman, and R. D. Kamm. Integrated in silico and 3D in vitro model of macrophage migration in response to tumor interstitial flow. *Integrative Biology*, 12:4, 90-108 (2020)

12. **R. J. Seager**, A. J. Acevedo, F. Spill and M. H. Zaman. Solid dissolution in a fluid solvent is characterized by the interplay of surface area-dependent diffusion and physical fragmentation. *Scientific Reports* (2018).
13. **R. J. Seager**, C. Hajal, F. Spill, R. D. Kamm and M. H. Zaman. Dynamic interplay between tumour, stroma, and immune system can drive or prevent tumour progression. *Convergent Science Physical Oncology*, **3**, 034002 (2017).
14. M. Solom, C. Chance, C. Pannier, **R. J. Seager**, A. E. Lee, J. Green, T. Duong, and P. Alicea. Risk analysis of the residual heat removal system at South Texas Project with a special focus on breach of containment. *2012 20th International Conference on Nuclear Engineering and the ASME 2012 Power Conference*, Anaheim, CA, **2**, 321-331 (2012).

†These authors contributed equally to this work..

## CONFERENCE ABSTRACTS

1. **R. J. Seager**, E. Van Roey, S. Gao, B. Burgher, P. DePietro, M. K. Nesline, R. Klein, S. Zhang, J. M. Conroy, and S. Pabla. Cancer testis antigen burden: Pan-cancer distribution and survival implications. *Cancer Research*, 82 (12\_Supplement), 5137-5137 (2022).
2. S Pabla, **R. J. Seager**, M. Nesline, P. DePietro, E. Van Roey, S. Gao, S. Ramkissoon, L. Deng, S. Zhang, R. Klein, and J. M. Conroy. Comprehensive genomic and immune profiling defines immunotherapy treatment in patients with NSCLC with low PD-L1 IHC. *Journal of Clinical Oncology*, 40 (16-suppl), 2623-2623 (2022).
3. M. K. Nesline, P. DePietro, Y. H. Lee, Z. Bliss, **R. J. Seager**, E. Van Roey, S. Gao, V. Giamo, Burgher, B. and Glenn, S. Novel immunotherapeutic targets in cancer of unknown primary (CUP). *Journal for ImmunoTherapy of Cancer*, 9 (Suppl 2) (2021).
4. P. DePietro, M. K. Nesline, Y. H. Lee, **R. J. Seager**, E. Van Roey, S. Gao, V. Giamo, B. Burgher, S. T. Glenn, and S. Zhang. Prevalence of secondary immunotherapeutic targets in the absence of established immune biomarkers in solid tumors. *Journal for ImmunoTherapy of Cancer*, 9 (Suppl 2), A86A86 (2021).
5. S. Mukherjee, **R. J. Seager**, Y. H. Lee, S. Pabla, and J. M. Conroy. Cancer/testis antigen expression landscape in gastroesophageal adenocarcinoma. *Annals of Oncology*, 32, S1068 (2021).
6. S. Mukherjee, **R. J. Seager**, Y. H. Lee, J. M. Conroy, and S. Pabla. Tumor inflammation and proliferative status as biomarkers in gastroesophageal adenocarcinoma. *Annals of Oncology*, 32 (Suppl 3), S204 (2021).
7. **R. J. Seager**, E. Van Roey, S. Gao, J. Andreas, V. Giamo, B. Burgher, F. Lenzo, M. K. Nesline, P. DePietro, and Y. Wang. Cancer testis antigen co-expression landscape in solid tumors. *Journal for ImmunoTherapy of Cancer*, 8 (Suppl 3) (2020).

## CONFERENCE PRESENTA- TIONS

1. S. Pabla, **R. J. Seager**, Y. H. Lee, E. Van Roey, S. Gao, V. Giamo, B. Burgher, P. DePietro, M. K. Nesline, and S. T. Glenn. Cancer testis antigen burden: A novel predictive biomarker for immunotherapy in solid tumors. *Journal for ImmunoTherapy of Cancer*, 9 (Suppl 2) (2021).
2. **R. J. Seager**, E. Van Roey, S. Gao, J. Andreas, V. Giamo, B. Burgher, F. L. Lenzo, M. K. Nesline, P. DePietro, Y. Wang, S. T. Glenn, S. Zhang, J. M. Conroy, and S. Pabla. Cancer testis antigen co-expression landscape in solid

tumors. *Poster presented at Society for the Immunotherapy of Cancer 25th Annual Meeting, Virtual* (November 9-14, 2020).

3. **R. J. Seager.** A simulated cytokine signaling network predicts that TAK1- and Smad7-mediated crosstalk facilitates interactions between TGF-1- and TNF-induced signaling in cancer cells. *Poster presented at NIH Interagency Modeling and Analysis Group Multiscale Modeling Consortium Meeting, Bethesda, MD* (March 6-7, 2019).
4. **R. J. Seager.** Decoding Tumor Development: Using computational tools to analyze cytokine signaling networks in cancer cells. *Presentation at Boston University Biomedical Engineering Symposium in Quantitative Biology and Physiology and Translational Research in Biomaterials, Boston, MA* (December 13, 2018).
5. **R. J. Seager.** Synergistic interactions between TGF- $\beta$ 1- and TNF $\alpha$ -induced signaling in cancer cells are the result of TAK1- and Smad7-mediated crosstalk. *Poster presented at NIH Interagency Modeling and Analysis Group Futures Meeting, Bethesda, MD* (March 21-22, 2018).
6. **R. J. Seager.** Solid dissolution in a fluid solvent is characterized by the interplay of surface area-dependent diffusion and physical fragmentation. *Poster presented at Boston University Biomedical Engineering Symposium in Quantitative Biology and Physiology and Translational Research in Biomaterials, Boston, MA* (December 15, 2017).

#### CONFERENCES ATTENDED

1. American Association of Cancer Research Annual Meeting 2022, New Orleans, LA (April 8-13, 2022).
2. Society for the Immunotherapy of Cancer 25th Annual Meeting, Virtual (November 9-14, 2020).
3. NIH Interagency Modeling and Analysis Group Multiscale Modeling Consortium Meeting 2019, Bethesda, MD (March 6-7, 2019).
4. NIH Interagency Modeling and Analysis Group Futures Meeting 2018 - Moving Forward with the MSM Consortium, Bethesda, MD (March 21-22, 2018).

#### AWARDS AND DISTINCTIONS

- National Merit Scholarship (August 2010 - May 2014)
- President's Endowed Scholar (August 2010 - May 2014)
- Director's Excellence Award (August 2010 - May 2014)
- University Scholar (May 2011 - May 2014)
- Stinson Scholarship (Nuclear Departmental Scholarship) (August 2010)
- Simmons Scholarship (Nuclear Departmental Scholarship) (April 2013)
- Tau Beta Pi Engineering Honor Society, Member (November 2013 - Present)
- Alpha Nu Sigma Nuclear Engineering Honor Society, Member (May 2013 - May 2014)
- Phi Kappa Phi Honor Society, Member (May 2013 - May 2014)
- Texas A&M Honors Fellow Graduation Distinction (August 2014)
- Texas A&M Dean's List (8 Semesters)
- Outstanding Achievement Award: Mechanics Scholar (December 2010)
- T.R. Spence Engineering Graphics Competition (2nd Place) (May 2011)

- Wilson High School Valedictorian (1st out of 90) (June 2010)
- Wilson High School Freshman Class President (2006 - 2007)
- Wilson High School Junior Class President (2008 - 2009)

## **TRAINING PROGRAMS**

- Quantitative Biology and Physiology Trainee

## **TEACHING EXPERIENCE**

### **Daemen University, Department of Business, Buffalo, NY**

1. Adjunct Professor, MBA 511: Data-Based Decision Making

### **Boston University, Kilachand Honors College, Boston, MA**

1. Teaching Fellow, KHC 302: Interdisciplinary Perspectives on Global Challenges II, Instructors: Christopher Gill, M.D., Muhammad Zaman, Ph.D., Carrie Preston, Ph.D. (Spring 2019)
2. Teaching Fellow, KHC 302: Interdisciplinary Perspectives on Global Challenges I, Instructors: Christopher Gill, M.D., Muhammad Zaman, Ph.D., Carrie Preston, Ph.D. (Spring 2018)

### **Boston University, Department of Biomedical Engineering, Boston, MA**

1. Teaching Fellow, ENG BE 200: Introduction to Probability, Instructors: Alyson Sgro, Ph.D., Kamal Sen, Ph.D. (Spring 2017)
2. Teaching Fellow, ENG BE 745: Nanomedicine: Principles and Applications, Instructor: Mario Cabodi, Ph.D. (Spring 2016)

## **PROFESSIONAL SOCIETIES & ACTIVITIES**

- **Society for the Immunotherapy of Cancer**, Member 2020
- **American Nuclear Society, Texas A&M Student Chapter**, Member August 2010 - May 2014
- **Texas A&M Student Engineers' Council**, Member September 2011 - May 2014

## **TECHNICAL SKILLS**

- Programming Languages: Python, R, C++, FORTRAN
- Mathematical Software: Matlab, Comsol
- Design and Drafting Software: Solidworks, AutoCAD
- Zaman Lab Webmaster ([www.bu.edu/zaman](http://www.bu.edu/zaman)) (2015-2019)
- OmniSeq Employee Resource Committee Member (April 2021 - Present)

## **NON-TECHNICAL ACHIEVEMENTS**

- Boston University Super Sax, Tenor Saxophone I (2017-2019)
- Boston University Big Band, Tenor Saxophone I (2015-2019)
- Performed with Boston Pops and Boston University Marching Band, Alto Saxophone I, BU Night at the Pops (May 20, 2017)
- Performed Duke Ellington's Sacred Music with Boston University Big Band conducted by Randall Keith Horton, final composing and conducting assistant to Duke Ellington, at special event "Hope Despair and the Blues: Boston University's Dr. Martin Luther King, Jr. Day Commemoration" (January 16, 2017)
- Texas A&M Jazz Ensemble I, Tenor Saxophone I (2010 - 2014)
- Texas A&M Hullabaloo Basketball Band, Alto Saxophone (2010 - 2014)

- Texas A&M Department of Communications Public Speaking Competition: First Place (2012)
- Sang backup vocals for Foreigner on "I Want to Know What Love Is" live in concert at ArtPark, Lewiston, NY (August 17, 2010)