

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Foran, David J., Ph.D.

eRA COMMONS USER NAME (credential, e.g., agency login): forandj

POSITION TITLE: Core Faculty Member

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Rutgers University, New Brunswick, NJ	BA	10/1983	Zoology & Physics
University of Medicine & Dentistry of New Jersey and Rutgers University, Piscataway, NJ	PHD	05/1992	Biomedical Eng. & Computer Science
University of Medicine & Dentistry of New Jersey – Robert Wood Johnson Medical School, Piscataway, NJ, Piscataway, NJ	Postdoctoral Fellow	06/1993	Biomedical Informatics

A. Personal Statement

I currently serve as Professor of Pathology, Laboratory Medicine & Radiology. A major concentration for my laboratory has been the development of a family of data-mining, imaging and computational tools for characterizing a wide range of malignancies and elucidating associations and relationships among computational markers and gene, molecular and protein expression signatures throughout the course of disease onset and progression. My training, experience and expertise gained while leading and supporting multi-investigator projects in computational imaging, computer-assisted diagnostics, bioinformatics, team-based software development and high-performance computing have provided me with the requisite tools and skills to work in partnership with basic, clinical and translational researchers to address fundamental problems in cancer detection, patient stratification, disease management, and outcomes studies. As part of my role on this application, I will provide the requisite oversight, experience, infrastructure, resources and tools to bring this effort to successful completion.

Ongoing and recently completed projects that I would like to highlight include:

NIH (UG3CA225021-03 & 4UH3CA225021-03)

Foran (MPI) with Saltz, Sharma

04/01/18-03/31/23

Methods and Tools for Integrating Pathomics Data into Cancer Registries

NIH (2P30CA072720-23)

Libutti (PI), Role: Contact PI /Project Leader/ Biomedical Informatics Shared Resource

03/01/19-02/28/24

Cancer Center Support Grant

NIH (UL1TR003017)

Panettieri (PI), Role: Co-Lead Biomedical Informatics Core

03/11/19-02/22/24

New Jersey Alliance for Clinical and Translational Science

Citations:

1. Ren J, Singer EA, Sadimin E, Foran DJ, Qi X. Statistical Analysis of Survival Models Using Feature Quantification on Prostate Cancer Histopathological Images. *J Pathol Inform*. 2019;10:30. PubMed Central PMCID: PMC6788183.
2. Yang L, Qi X, Xing F, Kurc T, Saltz J, Foran DJ. Parallel content-based sub-image retrieval using hierarchical searching. *Bioinformatics*. 2014 Apr 1;30(7):996-1002. PubMed Central PMCID: PMC3967099.
3. Foran DJ, Yang L, Chen W, Hu J, Goodell LA, Reiss M, Wang F, Kurc T, Pan T, Sharma A, Saltz JH. ImageMiner: a software system for comparative analysis of tissue microarrays using content-based image retrieval, high-performance computing, and grid technology. *J Am Med Inform Assoc*. 2011 Jul-Aug;18(4):403-15. PubMed Central PMCID: PMC3128405.
4. David J. Foran, Eric B. Durbin, Wenjin Chen, Evita Sadimin, Ashish Sharma, Imon Banerjee, Tahsin Kurc, Nan Li, Antoinette M. Stroup, Gerald Harris, Annie Gu, Maria Schymura, Rajarsi Gupta, Erich Bremer, Joseph Balsamo, Tammy DiPrima, Feiqiao Wang, Shahira Abousamra, Dimitris Samaras, Isaac Hands, Kevin Ward and Joel H. Saltz. An Expandable Informatics Framework for Enhancing Central Cancer Registries with Digital Pathology Specimens, Computational Imaging Tools & Advanced Mining Capabilities. *J Pathol Inform* 2022 Jan 5;13:5. doi: 10.4103/jpi.jpi_31_21. PMID: 35136672; PMCID: PMC8794027.

B. Positions, Scientific Appointments, and Honors

- 2021 - Chief Research Informatics Officer, Rutgers Biomedical and Health Sciences (RBHS)
- 2020 - Core Faculty Member, Rutgers Global Health Institute, Rutgers University
- 2020 - Invited, Plenary Speaker. 2020 NAACCR Annual Conference in Philadelphia, PA.
- 2018 - Full Member, Dept. of Electrical & Computer Engineering, Rutgers University.
- 2016 - Full Member, Quantitative Biomedicine Graduate Program, Rutgers University
- 2015 - Member, Informatics Steering Committee. Oncology Research Information Exchange Network (ORIEN) partnership of North America
- 2014 - Reviewer, Swiss National Science Foundation. Berne, Switzerland
- 2014 - 2020 - Standing Member, Biodata Management and Analysis (BDMA) Study Section for NIH – National Institute of Biomedical Imaging and Bioengineering
- 2013 - Reviewer, Biodata Management and Analysis (BDMA) Study Section for NIH – National Institute of Biomedical Imaging and Bioengineering
- 2013 - Pillar of Hope & Excellence Award, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ
- 2012 - Professor, CIO and Director Biomedical Informatics & Computational Imaging, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ
- 2011 - Associate Member of Graduate Faculty, Dept. of Computer Science, Rutgers University, New Brunswick, NJ
- 2011 - Associate Director, Medical and Health Informatics Research, Rutgers Discovery Informatics Institute (RDI2), Piscataway, NJ
- 2010 - Program and Organizational Committee & Chair, HP-MICCAI, Workshops on High Performance Computing in Biomedical Image Analysis at the Annual International Conferences of the Medical Image Computing and Computer Assisted Intervention Society
- 2010 - Member, NIH Special Emphasis Panel/Scientific Review Group 2010/05 ZRG1 HDM-G 12B
- 2009 - Chief, Division of Medical Informatics, Dept. of Pathology & Laboratory Medicine, Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ
- 2009 - Member, NIH Special Emphasis Panel/Scientific Review Group 2009/10 ZRG1 HDM-G (58)
- 2009 - Special Government Employee/Advisory Committee, U.S. Food and Drug Administration
- 2009 - Consultant, U.S. Food and Drug Administration
- 2008 - Tissue microarray project selected for recognition, American Association for Cancer Research (AACR) Society in a national campaign to highlight breakthrough cancer research to congressional leaders
- 2006 - Resident Member, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ

- 2006 - Professor, Joint appointment Depts. of Pathology, Laboratory Medicine and Radiology, Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ
- 2006 – 2012 Director, Histopathology & Imaging Core, Rutgers Cancer Institute of NJ, New Brunswick, NJ
- 2004 Invited Speaker, Imaging & Informatics for Investigative Pathology. Federation of American of American Societies for Experimental Biology (FASEB). Washington, DC
- 2003 Selected as Director, Scientific Program of the annual conference of the national Association of Pathology Informatics
- 2003 - 2006 Associate Professor, Joint appointment Depts. of Pathology, Laboratory Medicine & Radiology, Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ
- 2000 Chair, World Congress on Medical Physics & Biomedical Engineering. Session on Next Generation Informatics in Diagnostic Medicine
- 1998 - 2003 Biomedical Engineering Research Grant Recipient, Whitaker Foundation, Arlington, VA
- 1997 - Director & Co-founder, Center for Biomedical Imaging & Informatics, Rutgers- Robert Wood Johnson Medical School and, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ
- 1995 - Graduate Faculty, Computational Molecular Biology & Molecular Genetics, Rutgers University, Piscataway, NJ
- 1995 – 2003 Assistant Professor (Tenure Track, 1997), Joint appointment Depts. of Pathology, Laboratory Medicine & Radiology, Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ
- 1994 - Instructor, Dept. of Pathology & Laboratory Medicine, Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ
- 1993 - Postdoctoral Fellow, Dept. of Pathology & Laboratory Medicine Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ
- 1986 - 1988 Junior Scientist, Johnson & Johnson Research, North Brunswick, NJ

C. Contributions to Science

1. The process of discriminating among pathologies involving peripheral blood, bone marrow, and lymph node has traditionally begun with subjective morphological assessment of cellular materials viewed using light microscopy. The subtle visible differences exhibited by some malignant lymphomas and leukemia, however, give rise to a significant number of false negatives during microscopic evaluation by medical technologists. Working closely with a team of pathologists we developed advanced pattern recognition and content-based image retrieval technologies to quickly and reliably distinguish among these entities in spite of the morphologic similarities they exhibit. The computational imaging techniques that my team developed enabled quick, reliable comparison of unclassified novel cases with a gold-standard database of cases for which there was independent confirmation of the diagnoses through the use of immunophenotyping. During cross validation studies using nearly 4,000 specimens and 5 different classes of disorders resulted in 93.2% correct classification whereas completely open-set experiments using specimens originating from multiple institutions and exhibiting wide variations resulted in 87.2% correct classification.
 - a. Ren J, Hacihaliloglu I, Singer EA, Foran DJ, Qi X. Unsupervised Domain Adaptation for Classification of Histopathology Whole-Slide Images. *Front Bioeng Biotechnol.* 2019;7:102. PubMed Central PMCID: PMC6529804.
 - b. Foran DJ, Chen W, Chu H, Sadimin E, Loh D, Riedlinger G, Goodell LA, Ganesan S, Hirshfield K, Rodriguez L, DiPaola RS. Roadmap to a Comprehensive Clinical Data Warehouse for Precision Medicine Applications in Oncology. *Cancer Inform.* 2017;16:1176935117694349. PubMed Central PMCID: PMC5392017.
 - c. Yang L, Tuzel O, Chen W, Meer P, Salaru G, Goodell LA, Foran DJ. PathMiner: a Web-based tool for computer-assisted diagnostics in pathology. *IEEE Trans Inf Technol Biomed.* 2009 May;13(3):291-9. PubMed Central PMCID: PMC3683402.
 - d. Foran DJ, Comaniciu D, Meer P, Goodell LA. Computer-assisted discrimination among malignant lymphomas and leukemia using immunophenotyping, intelligent image repositories, and telemicroscopy. *IEEE Trans Inf Technol Biomed.* 2000 Dec;4(4):265-73. PubMed PMID: 11206811.
2. Tissue microarray analysis is especially challenging because, unlike the wells on a cDNA microarray chip which can generally be considered homogeneous, each histospot on a tissue microarray is heterogeneous

in their composition which complicates their analysis significantly. Depending on the type of tumor or tissue section analyzed, the area of interest may represent nearly the entire disc or only a small percentage thereof. For example, if the goal of the assay is to determine epithelial cell expression of a given marker, an algorithm must be developed that evaluates only that region of the specimen. If subcellular localization is part of the goal of the experiments then even more sophisticated imaging methods will be required. In July, 2006 IBM launched the "Help Defeat Cancer" project on the World Community Grid affording us the collective computational power of approximately 250,000 computers world-wide. By the end of the six-month project our team had generated reference library and correlated database of expression patterns and database equipped with advanced searching tools for more than 100, 000 imaged specimens. We demonstrated that the expression signatures that were generated as part of the project could be used as a means for sub-classifying different types and stages of disease.

- a. Ren J, Karagoz K, Gatza ML, Singer EA, Sadimin E, Foran DJ, Qi X. Recurrence analysis on prostate cancer patients with Gleason score 7 using integrated histopathology whole-slide images and genomic data through deep neural networks. *J Med Imaging (Bellingham)*. 2018 Oct;5(4):047501. PubMed Central PMCID: PMC6237203.
 - b. Kurc T, Qi X, Wang D, Wang F, Teodoro G, Cooper L, Nalisnik M, Yang L, Saltz J, Foran DJ. Scalable analysis of Big pathology image data cohorts using efficient methods and high-performance computing strategies. *BMC Bioinformatics*. 2015 Dec 1;16:399. PubMed Central PMCID: PMC4667532.
 - c. Su H, Shen Y, Xing F, Qi X, Hirshfield KM, Yang L, Foran DJ. Robust automatic breast cancer staging using a combination of functional genomics and image-omics. *Annu Int Conf IEEE Eng Med Biol Soc*. 2015;2015:7226-9. PubMed Central PMCID: PMC4918467.
 - d. Foran DJ, Yang L, Chen W, Hu J, Goodell LA, Reiss M, Wang F, Kurc T, Pan T, Sharma A, Saltz JH. ImageMiner: a software system for comparative analysis of tissue microarrays using content-based image retrieval, high-performance computing, and grid technology. *J Am Med Inform Assoc*. 2011 Jul-Aug;18(4):403-15. PubMed Central PMCID: PMC3128405.
3. Future progress in several key areas of cancer research and drug discovery will rely upon the capacity of investigators to reliably detect, characterize and track subtle molecular and morphologic changes that occur in the tumor environment during the transformation from the benign to cancerous state. As an extension of our team's prior work we have been designing, developing and evaluating the computational and imaging tools to perform reliable, non-linear finite element modeling based on atomic force microscopy (AFM) and micro force sensors based on micro-electro-mechanical systems (MEMS) to chronicle the changes in the mechanical characteristics, expression signatures and spatial distributions of biomarkers in the normal tissue samples with those collected throughout the primary stages of disease in breast cancer.
- a. Pandya HJ, Park K, Chen W, Goodell LA, Foran DJ, Desai JP. Toward a Portable Cancer Diagnostic Tool Using a Disposable MEMS-Based Biochip. *IEEE Trans Biomed Eng*. 2016 Jul;63(7):1347-53. PubMed Central PMCID: PMC4917475.
 - b. Pandya HJ, Kim HT, Roy R, Chen W, Cong L, Zhong H, Foran DJ, Desai JP. Towards an Automated MEMS-based Characterization of Benign and Cancerous Breast Tissue using Bioimpedance Measurements. *Sens Actuators B Chem*. 2014 Aug 1;199:259-268. PubMed Central PMCID: PMC4084740.
 - c. Roy R, Chen W, Cong L, Goodell LA, Foran DJ, Desai JP. Probabilistic estimation of mechanical properties of biomaterials using atomic force microscopy. *IEEE Trans Biomed Eng*. 2014 Feb;61(2):547-56. PubMed Central PMCID: PMC3966978.
 - d. Roy R, Chen W, Cong L, Goodell LA, Foran DJ, Desai JP. A Semi-Automated Positioning System for contact-mode Atomic Force Microscopy (AFM). *IEEE Trans Autom Sci Eng*. 2013 Apr;10(2) PubMed Central PMCID: PMC3840952.
4. Our team later received funding from IBM to extend the image guided decision support framework to meet the requirements of radiology applications. One of the most significant challenges confronted in this project was developing an objective means for co-registering image data sets across consecutive patient visits. To address this challenge, our team developed a parallel point matching co-registration algorithm. The method was shown to provide sub-voxel accuracy for co-registering 3D radiology datasets. 3D experiments

comparing the performance of the newly developed algorithm with those achieved using the Insight Segmentation and Registration Toolkit (ITK) and the algorithms developed at the French national institute for research in computer science and control (INRIA) demonstrated that performance using the new approach out-performed the other two methods. In a related set of studies, our team focused its efforts on identifying and evaluating image-based computational markers to reliably characterize tumor response following radioembolization therapy. The studies utilized baseline texture signatures to systematically stratify subjects into response categories. Results from those studies indicate that image-based signatures performed well when used to classify by serologic tumor marker change (96.7% accuracy), based on results from leave-one-out cross-validation experiments using support vector machine (SVM) classifiers.

- a. Qi X, Brown LG, Foran DJ, Noshier J, Hacıhaliloglu I. Chest X-ray image phase features for improved diagnosis of COVID-19 using convolutional neural network. *Int J Comput Assist Radiol Surg*. 2021 Feb;16(2):197-206. PubMed Central PMCID: PMC7794081.
- b. Wu Y, Kwon YS, Labib M, Foran DJ, Singer EA. Magnetic Resonance Imaging as a Biomarker for Renal Cell Carcinoma. *Dis Markers*. 2015;2015:648495. PubMed Central PMCID: PMC4644550.
- c. Gensure RH, Foran DJ, Lee VM, Gendel VM, Jabbour SK, Carpizo DR, Noshier JL, Yang L. Evaluation of hepatic tumor response to yttrium-90 radioembolization therapy using texture signatures generated from contrast-enhanced CT images. *Acad Radiol*. 2012 Oct;19(10):1201-7. PubMed Central PMCID: PMC3438382.
- d. Kim H, Parashar M, Foran DJ, Yang L. Investigating the Use of Cloudbursts for High-Throughput Medical Image Registration. *Proc IEEE/ACM Int Conf Grid Computing*. 2009 Oct 13;2009:34-41. PubMed Central PMCID: PMC2904524.

Complete List of Published Work in MyBibliography can be found at:

<http://www.ncbi.nlm.nih.gov/sites/myncbi/david.foran.1/bibliography/40833107/public/?sort=date&direction=ascending>