

# JOSEPH M. REINHARDT, PH.D.

ROY J. CARVER CHAIR IN BIOMEDICAL ENGINEERING  
PROFESSOR AND DEPARTMENT EXECUTIVE OFFICER  
ROY J. CARVER DEPARTMENT OF BIOMEDICAL ENGINEERING  
THE UNIVERSITY OF IOWA

## ACADEMIC APPOINTMENTS

2020–Present	Roy J. Carver Chair in Biomedical Engineering
2018–Present	Department Executive Officer (Chair), Roy J. Carver Department of Biomedical Engineering, University of Iowa, Iowa City, IA
2009–Present	Professor of Biomedical Engineering, University of Iowa, Iowa City, IA
2009–2016	Department Executive Officer (Chair), Department of Biomedical Engineering, University of Iowa, Iowa City, IA
2016–Present	Professor of Radiology (courtesy), University of Iowa, Iowa City, IA
2003–2009	Associate Professor of Biomedical Engineering, University of Iowa, Iowa City, IA
1997–2003	Assistant Professor of Biomedical Engineering, University of Iowa, Iowa City, IA
1996–1997	Assistant Research Scientist, Department of Radiology, University of Iowa College of Medicine, Iowa City, IA
1996–1999	Adjunct Assistant Professor of Radiology, University of Iowa, Iowa City, IA
1994–1995	Postdoctoral Research Fellow, Department of Radiology, University of Iowa, Iowa City, IA

## PROFESSIONAL POSITIONS

2003–Present	Co-Founder, VIDA Diagnostics, Inc., Iowa City, IA <a href="http://www.vidadiagnostics.com">http://www.vidadiagnostics.com</a>
1989–1990	Senior Engineer, Communications Research and Development, Wang Laboratories, Lowell, MA
1985–1989	Systems Engineer, Radar Systems Laboratory, Raytheon Company, Wayland, MA

## EDUCATION

1990–1994	Ph.D. The Pennsylvania State University, University Park, PA (Electrical Engineering) Dissertation Title: <i>Shape Representation and Automatic Object Extraction Using Mathematical Morphology</i> Advisor: Prof. W. E. Higgins
-----------	---

1985–1988	M.S. Northeastern University, Boston, MA (Electrical Engineering)
1981–1985	B.S. Carnegie Mellon University, Pittsburgh, PA (Electrical Engineering)

## HONORS AND AWARDS

2020	Elected Fellow, IEEE
2019	1 <sup>st</sup> place, AAPM Computed Tomography Ventilation Imaging Evaluation Challenge 2019 (CTVIE19), Wei Shao, Joseph M. Reinhardt, and Gary E. Christensen
2019	3 <sup>rd</sup> place, AAPM Computed Tomography Ventilation Imaging Evaluation Challenge 2019 (CTVIE19), Sarah E. Gerard, John E. Bayouth, and Joseph M. Reinhardt
2008	Honorable Mention Poster Award, SPIE Symposium on Medical Imaging, 2008, “Tracking the motion of the hyoid bone in videofluoroscopic swallowing studies”, Patrick Kellen, Darci Becker, Joseph M. Reinhardt, and Douglas van Daele
2008	Nominated for Graduate College “Outstanding Graduate Mentor” award for 2008.
2007	Honorable Mention Poster Award, SPIE Symposium on Medical Imaging, 2007, “Feature-based pairwise retinal image registration by radial distortion correction”, Sangyeol Lee, Michael Abramoff, and Joseph M. Reinhardt
2007	1 <sup>st</sup> place Siemens Preclinical CT Image of the Year for “Imaging and analysis for the assessment of the normal mouse lung,” acquired by Eric A. Hoffman, Geoffrey McLennan, Joseph M. Reinhardt, Gary E. Christensen, Deokiee Chon, Eman Namati, Jacqueline Namati, Lijun Shi, Joo Hyun Song, Kunlin Cao, and Jered Sieren from The University of Iowa, 2007.
2006	Elected Fellow, AIMBE
1998	Tau Beta Pi Excellence in Teaching Award, University of Iowa, Iowa City, IA.
1994	Graduate Research Award, The Pennsylvania State University, University Park, PA. Awarded top prize for research in Science and Engineering category for entry titled “Toward Efficient Morphological Shape Representation.”
1990–1991	Palmer Graduate Fellowship, The Pennsylvania State University, University Park, PA. Awarded for academic excellence.
1984	Tau Beta Pi Honor Society

## PROFESSIONAL MEMBERSHIPS

Fellow, AIMBE; Fellow, IEEE; Member, AAAS; Member, AAPM; Member, BMES; Member, Sigma Xi; Member, Tau Beta Pi; Member, IEEE Engineering in Medicine and Biology Society.

## TEACHING ACTIVITIES

### I. Classroom Teaching

Semester	Course	Course Title
Summer 2019	ENGR:2210	Electrical Circuits (online)
Summer 2018	ENGR:2210	Electrical Circuits (online)
Spring 2018	BME:2210	Bioimaging and Bioinformatics (team taught)
Spring 2018	ENGR:1300	Engineering Problem Solving II
Summer 2017	ENGR:2210	Electrical Circuits (online)
Spring 2017	BME:2210	Bioimaging and Bioinformatics (team taught)
Spring 2017	ENGR:1300	Engineering Problem Solving II
Summer 2016	ENGR:2210	Electrical Circuits (online)
Spring 2016	BME:1010	First-Year Forum
Summer 2015	ENGR:2210	Electrical Circuits (online)
Fall 2015	BME:5210	Medical Imaging Physics (team taught)
Fall 2015	BME:2210	Bioimaging and Bioinformatics (team taught)
Fall 2015	BME:3010	Leadership and Resourcefulness
Fall 2014	51:080	Bioimaging and Bioinformatics (team taught)
Fall 2014	51:092	Leadership and Resourcefulness
Spring 2014	51:080	Bioimaging and Bioinformatics (team taught)
Fall 2013	51:185	Physics of Medical Imaging
Fall 2013	51:080	Bioimaging and Bioinformatics (team taught)
Spring 2013	51:185	Physics of Medical Imaging
Fall 2012	51:080	Bioimaging and Bioinformatics (team taught)
Spring 2012	51:080	Bioimaging and Bioinformatics (team taught)
Fall 2011	51:185	Physics of Medical Imaging
Spring 2011	51:080	Bioimaging and Bioinformatics (team taught)
Fall 2010	51:185	Physics of Medical Imaging
Fall 2009	51:185	Physics of Medical Imaging
Spring 2009	51:060	Data Acquisition and Analysis (team taught)
Spring 2009	51:080	Data Acquisition and Analysis Lab (team taught)
Fall 2008	51:185	Physics of Medical Imaging
Spring 2008	51:186	Multi-dimensional Image Processing
Fall 2007	51:185	Physics of Medical Imaging
Spring 2007	59:008	Electrical Circuits
Spring 2007	51:060	Data Acquisition and Analysis (team taught)
Spring 2007	51:080	Data Acquisition and Analysis Lab (team taught)
Spring 2006	51:186	Multidimensional Image Processing (team taught)
Fall 2005	51:092	Leadership and Resourcefulness
Fall 2005	51:091	Professional Seminar
Fall 2005	51:060/161	Introduction to Biomedical Imaging
Spring 2005	59:006	Engineering Problem Solving II
Fall 2004	51:040/141	Biosystems Analysis I
Fall 2004	51:186	Physics and Analysis of Medical Images II
Spring 2004	51:185	Physics and Analysis of Medical Images I

Fall 2003	51:085/178	Biomedical Engineering Senior Design Project
Fall 2003	51:186	Physics and Analysis of Medical Images II
Fall 2002	51:085/178	Biomedical Engineering Senior Design Project
Fall 2002	51:185	Physics and Analysis of Medical Images I
Spring 2002	57:008	Electrical Circuits
Fall 2001	51:085/178	Biomedical Engineering Senior Design Project
Fall 2001	51:286	Contemporary Topics in Medical Imaging
Fall 2000	57:006	Engineering II
Fall 2000	51:185	Physics and Analysis of Medical Images I
Spring 2000	57:008	Electrical Circuits
Spring 2000	51:090	BME Freshman Forum
Fall 1999	51:040/141	Biosystems Analysis
Fall 1999	51:185	Physics and Analysis of Medical Images I
Fall 1999	51:189	Health Informatics I
Spring 1999	57:008	Electrical Circuits
Spring 1999	51:091	Professional Seminar
Spring 1999	51:189	Health Informatics I
Fall 1998	51:040/141	Biosystems Analysis
Fall 1998	51:185	Physics and Analysis of Medical Images I
Spring 1998	51:080/181	Biomeasurements
Spring 1998	51:189	Medical Informatics
Fall 1997	51:185	Physics and Analysis of Medical Images I
Fall 1997	96:283	Informatics Tools for Healthcare Decision Support
Spring 1997	51:080/180	Biomeasurements
Fall 1996	74:191	Medical Informatics
Spring 1996	51:186	Physics and Analysis of Medical Images II

## II. Postdoctoral Fellow Supervision

Trainee Name	Period	Current Position
Shiba Kuanar	April 2019–August 2020	
Sarah Gerard	January–March 2019	Postdoc, Harvard University

## III. Graduate Student Supervision

Student Name	Degree	Grad. Date	Current Position
Erik Cole	Ph.D.	May 2023	
Faizyab Chaudhary	Ph.D.	May 2024	
Zachary Althof	M.S.	May 2021	
Patrick Wilhelm	M.S.	May 2020	Rockwell Collins
Sarah Gerard	Ph.D.	Dec 2018	Post-doc, Harvard University
Sandeep Bodduluri	M.S.	May 2012	
	Ph.D.	Dec 2016	Asst. Professor, Univ. of Alabama
Yang Wook Kim	M.S.	Aug. 2013	Samsung Corp.
Kaifang Du <sup>1</sup>	M.S.	Aug. 2011	
	Ph.D.	May 2013	Medical Physicist Residency
Vinayak Joshi <sup>2</sup>	Ph.D.	Dec. 2012	Engineer, VisionQuest Biomedical
Xiayu Xu <sup>2</sup>	M.S.	Dec. 2010	
	Ph.D.	Dec. 2012	Asst. Professor, Xi'an Univ.
Richard Amendola	M.S.	May 2012	Medical School
Panfang Hua	M.S.	Dec. 2010	Software Engineer
Tarunashree Yavarna	M.S.	Dec. 2010	Software Engineer
Kai Ding	M.S.	Aug. 2008	
	Ph.D.	May 2010	Asst. Professor, Johns Hopkins Univ.
Matthew Ternus	M.S.	Dec. 2009	Systems Engineer, Cerner Corp.
Shalmali Bodas	M.S.	Dec. 2008	Medical Physicist, Emory University
Sudharshan Bommu	M.S.	Dec. 2008	Engineer, Abbott Labs
Lijun Shi	M.S.	Dec. 2008	Senior Engineer, TerraRecon
Sangyeol Lee <sup>2</sup>	Ph.D.	May 2008	Research Engineer, Alcon Corp.
Patrick Kellen	M.S.	May 2008	Software Engineer, VIDA Diagnostics
Soumik Ukil	Ph.D.	Dec. 2006	Senior Engineer, TerraRecon
Jennifer Dempsey	M.S.	May 2006	Engineer, VA Hospital
Yan Pan	M.S.	May 2005	Engineer, GE Medical Systems
Lina Arbach	Ph.D.	May 2005	Senior Scientist, Philips Medical Systems
Baojun Li	Ph.D.	Dec. 2004	Asst. Professor, Boston Univ.
Atilla Kiraly <sup>3</sup>	Ph.D.	May 2003	Senior Engineer, Siemens Corporate R&D
Deepa Gopalakrishnan	M.S.	Dec. 2002	Ph.D. student, UCLA
Li Zhang	Ph.D.	Dec. 2002	Senior Engineer, Siemens Corporate R&D
Osama Saba	M.S.	May 2001	Lecturer, Univ. of Iowa
Shiyang Hu	M.S.	May 2001	Engineer, TerraRecon
Deniz Bilgen	M.S.	Dec. 2000	Member Technical Staff, Oak Ridge National Labs

<sup>1</sup>Jointly supervised with J. E. Bayouth, The Univ. of Iowa.<sup>2</sup>Jointly supervised with M. D. Abrámoff, The Univ. of Iowa.<sup>3</sup>Jointly supervised with W. E. Higgins, Penn State Univ.

#### IV. Special Student Recognitions

1. Shalmali Bodas, Best Poster Award (Biomedical Imaging Group), College of Engineering Research Day, 2008.
2. Patrick Kellen, Honorable Mention Poster Award, SPIE Symposium on Medical Imaging, 2008.
3. Sangyeol Lee, Honorable Mention Poster Award, SPIE Symposium on Medical Imaging, 2007.
4. Sangyeol Lee, First Place, Math, Physical, and Engineering Sciences Division, James F. Jakobsen Graduate Student Conference, 2007.
5. Soumik Ukil, First Place, Math, Physical, and Engineering Sciences Division, James F. Jakobsen Graduate Student Conference, 2006.

#### SERVICE ACTIVITIES

**Department:** Department Executive Officer, March 1, 2018–Present; Member, Medical Imaging Faculty Search Committee, 2017–2018; Department Executive Officer, March 1, 2009–June 30, 2016; Chair, Undergraduate Program Committee, 2008–2009; Chair, Undergraduate Program Committee, 2007–2008; Chair, Departmental Consulting Group on Promotions and Tenure, 2007–2008; Member, DEO Search Committee, 2007–2008; Chair, Undergraduate Program Committee, 2006–2007; Member, Departmental Consulting Group on Promotions and Tenure, 2006–2007; Chair, Departmental Consulting Group on Promotions and Tenure, 2005–2006; Undergraduate Program Committee, 2005–2006; Member, Departmental Consulting Group on Promotions and Tenure, 2004–2005; Undergraduate Program Committee, 2004–2005; Research Thrust Committee, 2004–2005; Member, Departmental Consulting Group on Promotions and Tenure, 2003–2004; Chairman, Undergraduate Program Committee, 2003–2004; Member, Strategic Planning Committee, 2002–2003; Undergraduate Internship Coordinator, 2001–2004; Member, Undergraduate Curriculum Committee, 2002–2003; Member, Graduate Program Enhancement Committee, 2001–2002; Assistant Program ABET Coordinator, 2001–2002; Chairman, Teaching Equipment Purchasing Committee, 2000–2001; Chairman, Digital Signal Processing Faculty Search Committee, 2001; Chairman, Strategic Planning Committee, 1999–2000; Chairman, Academic Affairs Committee Task force on new BME Fundamentals Course, 2000; Member, Department Enhancement Committee, 1999–2000; Faculty Secretary, 1997–1998; Faculty Secretary, 1998–1999; Member, Graduate Committee, 1997–1998.

**College:** Chair, APR Revision Task Force, 2020–2021; Chair, Iowa Flood Center director review committee, 2019; Member, Senior HR Director search committee; 2019; Member, Strategic Planning Committee, 2018; Member, Dean’s Advisory Instructional Faculty Promotion Committee, 2017–2018; Member, Teaching Committee, 2007–2008; IEEE Student Chapter Faculty Mentor, 2005–2007; Chair, Engineering Faculty Council, 2004–2005; Member, Engineering Faculty Council, 2003–2006; Member, EFC Computer Services Committee, 2003–2004; Member, College of Engineering Curriculum Committee, 2001–2002; Member, Faculty Outreach Planning Committee, Fall 2000; Member, College of Engineering Internship Director search committee, Fall 2000; Faculty Secretary, 1999–2000.

**University:** I-CLIC CT Research Facility Advisory Committee (NIH S10-130883); Faculty Senator, 2017–2020; Member, Vice President for Research UI-ISU Collaboration Pilot Grant Program Review Committee, Spring 2018; Member, College of Engineering Decanel Review Committee, Spring 2017; Chair, Search Committee for Director of National Advanced Driving Simulator, University of Iowa, Fall 2015–Spring 2016; Member, Review Committee for Department of Radiology, University of Iowa, Spring 2016; Member, TIER Presidential Advisory Board, Fall 2015/Spring 2016; Member, Interdisciplinary Program in Health Informatics Executive Committee, 2016; Member, Interdisciplinary Program in Health Informatics Executive Committee, Fall 2015; Member, Orthopaedics and Rehabilitation Associate Chair for Research Search Committee, Fall 2014/Spring 2015; Member, Director of Neurosciences Research Institute, Fall 2014/Spring 2015; Member, Head of Orthopaedics and Rehabilitation Search Committee, Spring 2013; Member, Director of Sponsored Programs Search Committee, Spring 2012; Member, Vice President for Research Conflict of Interest In Research Committee, AY 2008-2011; Member, Vice President for Research Internal Selection Committee for Biological Science Funding Programs, 2008; Judge, Jakobsen Conference, 2008; Member, Vice President for Research Internal Selection Committee for Biological Science Funding Programs, 2007; Judge, Jakobsen Conference, 2006; Member, Vice President for Research Internal Selection Committee for Major Research Equipment Grant Proposals, 2004; Member, Vice President for Research Advisory Committee on Biological Sciences, 2000-2003; Member, Grant Accounting Internal Review Committee, Fall 2001.

**External:** European Science Foundation College of Experts, July 2020–present; AIMBE Fellow Selection Committee, 2019, 2020; Workshop Co-Organizer: “Interaction of Geometry and Topology in Biomedical Imaging,” IEEE International Symposium on Biomedical Imaging (ISBI) 2020; Clinical Program Committee, IEEE International Symposium on Biomedical Imaging (ISBI) 2020; European Science Foundation Review Panel, Nov. 2019; VA PULM study section, Nov. 2018; Organizing Committee, AAPM VAMPIRE19 Grand Challenge; Program Committee, IEEE International Symposium on Biomedical Imaging (ISBI) 2019; Reviewer, FONDECYT-CHILE program 2018; Program Committee, IEEE International Symposium on Biomedical Imaging (ISBI) 2018; Program Committee, IEEE International Symposium on Biomedical Imaging (ISBI) 2017; Program Committee, Bioimaging 2017; 2016 Special Session Chair, IEEE International Symposium on Biomedical Imaging (ISBI) 2016, Special Session: Frontiers in Pulmonary Image Analysis Program Committee, IEEE International Symposium on Biomedical Imaging (ISBI) 2016; Session Chair, Machine Learning in Medical Imaging Workshop, October 2016; Member of Long Range Planning Committee for the Council of Chairs of Bioengineering and Biomedical Engineering, 2013–2015; Associate Editor, SPIE Journal on Medical Imaging, 2013–present; Program Committee, Quantitative Medical Imaging Meeting, Imaging and Applied Optics Congress, Optical Society of America Meeting 2013; Symposium Co-Chairman, SPIE Symposium on Medical Imaging 2012; Symposium Co-Chairman, SPIE Symposium on Medical Imaging 2011; Co-Organizer, ICASSP Special Session on Image Processing, 2011; Member, NIH-CSR-Small Business RES July 14-15, 2011 Meeting; Reviewer, NIH Director’s New Innovator Awards, Jan. 2010; Reviewer, NIH NCRP P41 site visit team, Feb. 2010; Workshop Organizer, Grand Challenge: Medical Image Segmentation and Registration in the Clinic, 2010; Workshop Organizer, Third Annual Workshop on Pulmonary Imaging, 2010; Workshop Organizer, Second Annual Workshop on Pulmonary Imaging, 2009; Workshop Organizer, First Annual Workshop on Pulmonary

Imaging, 2008; Program Committee, International Summit on the Future of Quantitative and Functional Lung Imaging, 2008; Organizer, Iowa Workshop on Lung Image Processing, Feb. 2008; Program Committee, International Conference on Pattern Recognition, 2008; Program Committee, SPIE Medical Imaging 2009: Image Processing Conference; Program Committee, International Symposium on Biomedical Imaging, 2008; Conference Chairman, SPIE Medical Imaging 2005–2008: Image Processing Conference; Reviewer, Dutch Science Foundation (NWO) Innovational Research Incentives Scheme, 2006, 2007; Member, NIH SBIR ZRG1-BST-L 51 Study Section on “Continued Development and Maintenance of Software”, Jan. 17-18, 2006; Scientific Review Committee, Computer Vision Approaches to Medical Image Analysis, 2005; Associate Editor, IEEE Transactions on Medical Imaging, 2005 - 2016; Scientific Review Committee, Information Processing in Medical Imaging Conference, 2005–2007; Scientific Review Committee, International Association of Science and Technology for Development Biomedical Engineering Conference, 2005-2007; External Reviewer, National Science and Engineering Research Council, Canada, 2005; Associate Editor, IEEE Transactions on Information Technology in Biomedicine, 2004, 2005; Program Committee, Computer Vision Approaches to Medical Image Analysis Workshop, 2004; Program Committee, IEEE International Symposium on Biomedical Imaging, 2003, 2005, 2007; Program Committee, SPIE Medical Imaging 2001–2004: Image Processing Conference; Scientific Review Committee, Information Processing in Medical Imaging Conference, 2003; Newsletter Editor, ASEE Biomedical Engineering Division 2001, 2002; Peer Review Committee, NSF SBIR Panel on Visualization and Imaging, Sept. 2001; Review Panelist, Civilian Research and Development Foundation, U.S. Department of State, June 2001; Program Committee, IEEE Southwest Symposium on Image Analysis, 2000; Newsletter Editor, ASEE Biomedical Engineering Division 2000; Ad-Hoc Member, NIH SBIR ZRG1-SSS-8 Study Section on Bioengineering and Physiology, Oct. 26-27, 1998; Ad-Hoc Member, NIH NHLBI Study Section on “Neurobiology of sleep and sleep apnea, airway biology, and pathogenesis of cystic fibrosis and acute lung injury”, Jan. 8, 1998; Program Committee, 1998 Symposium on Cardiovascular Imaging, University of Iowa; Program Committee, SPIE Medical Imaging 1997 Conference: Physiology and Function; Session Chairman, SPIE Medical Imaging 1997 Conference: Physiology and Function; Member, ISO X3S3.3 technical committee (OSI network layer), 1989–1990.

**Other Outreach and Service:** Participant, “Explore Engineering Day”, January 29, 2011; Coordinator, Workplace Learning Connection Program visit to Biomedical Engineering, January 19, 2011; Participant, “Explore Engineering Day”, March 27, 2010; Coordinator, Workplace Learning Connection Program visit to Cellular Engineering Technologies and VIDA Diagnostics, April 14, 2010; Middle school STEM outreach program, April 13, 2010; “Introduction to Biomedical Engineering” panelist for area high school students, November 10, 2009; Participant, Freshman/Parent Summer Orientation Program, 2009; Participant, “Explore Engineering Day”, April 18, 2009; Participant, Freshman/Parent Summer Orientation Program, 2007; Participant, Freshman/Parent Summer Orientation Program, 2006; Speaker, Gladbook-Reinbeck High School Career Day, 2006; Speaker, College of Engineering Workplace Learning Connection Program, 2006; Participant, Freshman/Parent Summer Orientation Program, 2005; Participant, Freshman/Parent Summer Orientation Program, 2004; Participant, Freshman/Parent Summer Orientation Program, 2003; “Introduction to X-ray Imaging” program for Horn Elementary School science curriculum, Sept. 23, 2003; Participant, Freshman/Parent Summer Orientation Program, 2002; NSPE Review Session



Leader (Circuits), Spring 2002; Participant, Freshman/Parent Summer Orientation Program, 2001; Participant, Engineering Day, 2001; NSPE Review Session Leader (Circuits), Spring 2001; Participant, Engineering Day, 2000; Participant, Engineering Day, 1999; Participant, Freshman/Parent Summer Orientation Program, 1999; Participant, Engineering Day, 1999; Judge, 1999 State Invention Convention, Ames, Iowa; Participant, Freshman/Parent Summer Orientation Program, 1998; Participant, Engineering Day, 1998.

**Journal Reviewing:** *Computer Vision and Image Understanding; IEEE Transactions on Biomedical Engineering; IEEE Transactions on Image Processing; IEEE Transactions on Signal Processing; IEEE Transactions on Medical Imaging; IEEE Transactions on Pattern Analysis and Machine Intelligence; IEEE Computer Graphics and Image Processing; Automedica; Annals of Biomedical Engineering; Journal of Visual Communication and Image Representation; Multidimensional Systems and Signal Processing; Medical Image Analysis; Pattern Recognition*

## RESEARCH FUNDING

### Grants and Contracts as Principal Investigator

NHLBI, National Institutes of Health: *R01 HL151421, Structural Determinants of Disease Progression in COPD*. JM Reinhardt, Iowa site PI (Bhatt, project PI). Annual amount: \$2,637,144 total direct costs. 04/05/20-03/31/25.

NHLBI, National Institutes of Health: *T32 HL144461, Iowa Lung Imaging Training Program*. EA Hoffman and JM Reinhardt, MPI. Annual amount: \$1,553,354 total direct costs. 08/01/19-07/31/24.

NHLBI, National Institutes of Health: *R01 HL142625, Lung Biomechanics and Disease Progression in SPIROMICS*. JM Reinhardt, PI. Annual amount: \$448,905 direct costs year 1. 08/01/18-05/31/22.

NCI, National Institutes of Health: *R01 CA166703, Predicting Pulmonary Function Change to Improve Radiation Planning and Outcome*. JM Reinhardt, PI of Iowa subcontract; JE Bayouth, project PI. Annual amount: \$2,435,546 total direct costs. 6/1/13-3/31/18.

University of Iowa: *Developmental Leave*. JM Reinhardt, PI. Annual amount: 100% salary support. Fall 2016.

Cystic Fibrosis Foundation: *Tracking insufflated microdisks to quantify MCT in CF*. Reinhardt, PI; M. Welsh, program director. Annual amount: \$40,000/year direct costs. 6/1/14-5/31/16. (This pilot and feasibility project supports one PhD student to study the use of image analysis to quantify mucocilliary transport in normals and in CF.)

NHLBI, National Institutes of Health: *R01 HL079406, CT measurement of regional lung mechanics*. JM Reinhardt, PI. Annual amount: \$225,000 direct costs per year. 4/06-7/12.

Vital Images, Inc.: *Jennifer Dempsey BS/MS Project: Colonography Image Registration*. JM Reinhardt, PI. Annual amount: \$8,623 direct costs. 6/04-5/05.

University of Iowa: *Developmental Leave*. JM Reinhardt, PI. Annual amount: 100% salary support. Spring 2003.

Whitaker Foundation: *Transition Year: Measurement of Lung Parenchymal Strain via X-ray CT*. JM Reinhardt, PI. Annual amount: \$76,250 direct costs per year. 9/01–8/02.

National Science Foundation: *CAREER: Program in Pulmonary Imaging*. JM Reinhardt, PI. Annual amount: \$75,000 direct costs per year. 3/01–2/06.

Whitaker Foundation: *Biomedical Engineering Internship Program at the University of Iowa*. JM Reinhardt, PI. Annual amount: \$60,000 direct costs per year. 7/00–6/03.

University of Iowa: *Old Gold Summer Fellowship*. JM Reinhardt, PI. Annual amount: 1 month salary. Summer 1999.

Whitaker Foundation: *Measurement of Lung Parenchymal Strain via X-ray CT*. JM Reinhardt, PI. Annual amount: \$70,000 direct costs per year. 4/97–2/01.

Environmental Health Sciences Research Center (University of Iowa): *Accurate Measurement of Intrathoracic Airways*. JM Reinhardt, PI. Annual amount: \$15,000 direct costs. 4/97–3/98.

### Grants and Contracts as Co-Investigator

NHLBI, National Institutes of Health: *U01 HL137880, SPIROMICS II: Biological Underpinnings of COPD Heterogeneity and Progression*. JM Reinhardt, co-Investigator, 5% salary support, (P. Woodruff, PI). Annual amount: \$6,092,935. 09/15/17-05/31/22.

NHLBI, National Institutes of Health: *R01 HL111453, Expanding objective CT-based phenotyping to lungs with enhanced radiodensities*. JM Reinhardt, Co-Investigator, 5% effort, (R. Beichel, PI). Annual amount: \$355,570. 1/1/2012–12/31/2014.

Carver College of Medicine Collaborative Pilot Grant: *Quantifying radiation induced changes in pulmonary function in irradiated and un-irradiated lung tissue*. JM Reinhardt, Co-investigator (J. Bayouth, PI). Annual amount: \$50,000. 7/1/2009–6/30/2010.

NHLBI, National Institutes of Health: *R01 HL092056, Lung alterations in acute exacerbations of COPD*. JM Reinhardt, Co-investigator, 10% salary support plus grad RA, (K. Doerschug, PI). Annual amount: \$250,000 per year. 7/15/2009–6/30/2011.

NHLBI, National Institutes of Health: *S10RR024738, Vertical MR System Shared Instrumentation Grant*. JM Reinhardt, Co-Investigator, 0% salary support, (Eric A. Hoffman, PI). Annual amount: \$500,000. 7/09–6/10.

NSF: *S10RR22421, Large-Scale Computing and Visualization for Cardiopulmonary Imaging*. JM Reinhardt, Co-Investigator, 0% salary support, (Ching-Long Lin, PI). Annual amount: \$473,636. 1/08–1/11.

NCI, National Institutes of Health: *R01 CA129022, Precise correspondence of 3D Pathology with radiological features in lung nodules*. JM Reinhardt, Co-Investigator, 3% effort, (G. McLennan, PI). Annual amount: \$306,354 per year. 9/07-8/12.

NHLBI, National Institutes of Health: *R01 HL080285, Quantitative CT-based lung atlas of the mouse*. JM Reinhardt, Co-Investigator, 10% effort plus grad RA, (Eric A. Hoffman, PI). Annual amount: \$400,000 per year. 4/06–3/11.

NEI, National Institutes of Health: *R01 EY017066, Low cost, patient friendly, portable imaging of diabetic retinopathy*. JM Reinhardt, Co-Investigator, 5% effort plus grad RA, (M. Abramoff, PI). Annual amount: \$237,903 per year. 9/05-7/09.

The University of Iowa: *Academic Technologies Instructional Computing Award*. JM Reinhardt, Co-Investigator, 0% salary support, (G. Thomas, PI). Annual amount: \$50,000. 12/06–8/07.

NHLBI, National Institutes of Health: *Image and Model Based Analysis of Lung Disease*. JM Reinhardt, Co-Investigator, 15% effort plus grad RA, (E. A. Hoffman, PI). Annual amount: \$1,993,762 per year. 7/05–6/10.

Pacific Northwest National Labs: *Lung atlas development, subcontract #14624*. JM Reinhardt, Co-Investigator, RA salary support, (E. A. Hoffman, PI). Annual amount: \$30,000 per year. 8/05-7/10.

Confirma, Inc.: *Breast MRI lesion classification*. JM Reinhardt, Co-Investigator, Grad RA salary support, (A. Stolpen, PI). Annual amount: \$5,000. 1/04–12/04.

NCI, National Institutes of Health: *Virtual true-color bronchoscope to detect lung cancer*. JM Reinhardt, Co-Investigator, 5% effort plus grad RA, (G. McLennan, PI). Annual amount: \$300,000 per year. 9/02–9/06.

NHLBI, National Institutes of Health: *Lung image database with pathologic correlates*. JM Reinhardt, Co-Investigator, 3% effort plus grad RA, (G. McLennan, PI). Annual amount: \$267,170 per year. 9/01–8/06.

NCCAM, National Institutes of Health: *Does spinal manipulation speed determine neural response?*. JM Reinhardt, Co-Investigator, 5% effort, (J. Pickar, PI). Annual amount: \$125,000 per year. 8/01–7/03.

NCI, National Institutes of Health: *Quantitative Medical Imaging Training Grant*. JM Reinhardt, Co-Investigator, RA salary support, (R. Hichwa, PI). Annual amount: \$100,000 per year. 7/00-6/05.

Whitaker Foundation: *ASEE Annual Meeting Travel Grant*. JM Reinhardt, Participant, (J. Winters, PI). Annual amount: \$750. 6/00.

NHLBI, National Institutes of Health: *Image and Model Based Analysis of Lung Disease*. JM Reinhardt, Co-Investigator, 15% salary support plus grad RA, (E. A. Hoffman, PI). Annual amount: \$1,846,154 per year. 12/99–11/04.

NHLBI, National Institutes of Health: *Inflammatory Parenchymal Lung Disease*. JM Reinhardt, Co-Investigator, 10% salary support plus grad RA, (E. A. Hoffman, PI). Annual amount: \$298,674 per year. 7/99–6/04.

Joseph M. Reinhardt, Ph.D.

Environmental Protection Agency: *Assessment of Variations in Human Airway Geometry and the Implications for Evaluation of Particle Deposition and Dose to Different Populations*. JM Reinhardt, Co-Investigator, Grad RA salary support, (B.S. Cohen, PI). Annual amount: \$25,000 per year. 6/99–5/01.

National Science Foundation: *3-D Cardiac Ultrasound Image Analysis*. JM Reinhardt, Co-Investigator, 5% effort, (E. L. Dove, PI). Annual amount: \$75,000 per year. 1/99–12/00.

Cystic Fibrosis Center University of Iowa: *Laser fluorescent bronchoscopy*. JM Reinhardt, Co-Investigator, Grad RA salary support, (G. McLennan, PI). Annual amount: \$45,000 per year. 9/98–8/00.

Whitaker Foundation: *Collaborative Educational Environment for Functional Cardiovascular Image Analysis*. JM Reinhardt, Co-Investigator, equipment and staff salary support, (K. B. Chandran, PI). Annual amount: \$308,517 per year. 2/98–6/02.

Cervical Spine Research Society: *Biomechanics of Ligamentous Spine and Spinal Cord during Whiplash and Post-Whiplash*. JM Reinhardt, Co-Investigator, RA salary support, (V. K. Goel, PI). Annual amount: \$30,000 per year. 11/98–10/99.

## OTHER SIGNIFICANT FUNDING

The Carver Charitable Trust. Project title: *Biomedical Engineering to Address Respiratory and Pulmonary Disease*. Project period: 1/1/2019-12/31/2027. Budget: \$12,000,000 total direct costs. Joseph M. Reinhardt, program director.

This gift will be used to rapidly expand the research capabilities of the Biomedical Engineering Department by hiring five new tenure-track faculty in the areas of respiratory and pulmonary biomedical engineering. Funds from the gift will be used to support faculty start-up and PhD graduate students. A portion of this gift will be used to create a permanent endowment to enhance research and graduate education in the Department and to create a number of endowed professorships.

**This gift is the largest gift ever received by the Department or by the College of Engineering.**

In recognition of this gift and the previous significant support to the Department from the Carver Charitable Trust over the past two decades, the Department was renamed to be “The Roy J. Carver Department of Biomedical Engineering.”

## PATENTS

Geoffrey McLennan, Martin Donnelley, Deepa Gopalakrishnan, Eric Hoffman, Joseph Reinhardt and Melissa Suter, “Methods and devices useful for analyzing color medical images,” U.S. Patent No. 7,613,335. Issued November 3, 2009.

Joseph M. Reinhardt, Soumik Ukil, Milan Sonka, Geoffrey McLennan, and Eric A. Hoffman, “Methods of smoothing segmented regions,” U.S. Patent No. 8,073,210. Issued December 6, 2011.

Michael Abramoff, Sangyeol Lee, Joseph M. Reinhardt, and Meindert Niemeijer, “Optimal Registration of Multiple Deformed Images using a Physical Distortion Model of the Imaging Distortion,” U.S. Patent No. 8,194,936. Issued June 5, 2012.

Juerg Tschirren, Milan Sonka, Geoffrey McLennan, Eric Hoffman, and Joseph Reinhardt, “Methods and devices for airway tree labeling and/or matching,” U.S. Patent No. 8,155,403. Issued April 10, 2012.

Juerg Tschirren, Milan Sonka, Joseph Reinhardt, Geoffrey McLennan, and Eric Hoffman, “Methods and devices for labeling and/or matching,” U.S. Patent No. 9,820,651. Issued November 21, 2017.

Michael D. Abramoff, Meindert Niemeijer, Xiayu Xu, Milan Sonka, and Joseph M. Reinhardt, “Automated determination of arteriovenous ratio in images of blood vessels,” U.S. Patent No. 9,924,867. Issued March 27, 2018.

## PATENT APPLICATIONS

Sarah E. Gerard and Joseph M. Reinhardt “Fissurenet: A Deep Learning Approach for Pulmonary Fissure Detection in CT Images,” US Patent App. 16/914,972, Filed on June 27, 2019.

Eric A. Hoffman, Amin Motahari Bidgoli, and Joseph M. Reinhardt “Regional pulmonary V/Q via image registration and multi-energy CT,” U.S. Provisional Application No. 62/846,394. Filed on May 10, 2019.

## PUBLICATIONS

### I. Books

- [1] K. B. Chandran, H. S. Udaykumar, and **J. M. Reinhardt**, Eds., *Image-Based Computational Modeling of the Human Circulatory and Pulmonary Systems*. Springer, 2011.

### II. Conference and Workshop Proceedings

- [1] J. M. Fitzpatrick and **J. M. Reinhardt**, Eds., *Medical Imaging 2005: Image Processing*, vol. 5747, The Proceedings of the SPIE, International Society for Optical Engineering, 2005.
- [2] **J. M. Reinhardt** and J. P. Pluim, Eds., *Medical Imaging 2006: Image Processing*, vol. 6144, The Proceedings of the SPIE, International Society for Optical Engineering, 2006.
- [3] **J. M. Reinhardt**, B. van Ginneken, and M. Sonka, *Guest editorial: Pulmonary image processing*, Special Issue on Pulmonary Imaging, Apr. 2006.
- [4] J. P. Pluim and **J. M. Reinhardt**, Eds., *Medical Imaging 2007: Image Processing*, vol. 6512, The Proceedings of the SPIE, International Society for Optical Engineering, 2007.

- [5] J. Z. Liang, H. Lu, D. N. Metaxas, and **J. M. Reinhardt**, *Guest editorial: Medical imaging informatics — information processing from image formation to visualization*, Special Issue on Medical Image Reconstruction, Processing and Visualization, Jan. 2007.
- [6] **J. M. Reinhardt** and J. P. Plum, Eds., *Medical Imaging 2008: Image Processing*, vol. 6914, The Proceedings of the SPIE, International Society for Optical Engineering, 2008.
- [7] M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J.-M. Kuhnigk, C. Lorenz, K. Mori, and **J. M. Reinhardt**, Eds., *Proceedings of the First International Workshop on Pulmonary Image Analysis*, <http://www.lulu.com/content/3507981>, 2008.
- [8] M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J.-M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., *Proceedings of the Second International Workshop on Pulmonary Image Analysis*, <http://www.amazon.com/Second-International-Workshop-Pulmonary-Analysis/dp/1448680891>, 2009.
- [9] M. Brown, M. de Bruijne, B. van Ginneken, K. Ding, A. Kiraly, J.-M. Kuhnigk, J. R. McClelland, K. Mori, and **J. M. Reinhardt**, Eds., *Proceedings of the Third International Workshop on Pulmonary Image Analysis*, <http://www.amazon.com/Third-International-Workshop-Pulmonary-Analysis/dp/1453776001>, 2010.

### III. Rigorously Reviewed Journal Articles

- [1] **J. M. Reinhardt** and W. E. Higgins, “Comparison between the morphological skeleton and morphological shape decomposition,” *IEEE Trans. Patt. Anal. Machine Intell.*, vol. 18, no. 9, pp. 951–957, Sep. 1996.
- [2] **J. M. Reinhardt** and W. E. Higgins, “Efficient morphological shape representation,” *IEEE Trans. Image Proc.*, vol. 5, no. 1, pp. 89–101, Jan. 1996.
- [3] **J. M. Reinhardt**, N. D. D’Souza, and E. A. Hoffman, “Accurate measurement of intra-thoracic airways,” *IEEE Trans. Medical Imaging*, vol. 16, no. 6, pp. 820–827, Dec. 1997.
- [4] **J. M. Reinhardt** and W. E. Higgins, “Paradigm for shape-based image analysis,” *Optical Engineering*, vol. 37, no. 2, pp. 570–581, Feb. 1998.
- [5] **J. M. Reinhardt** and E. A. Hoffman, “Quantitative pulmonary imaging: Spatial and temporal considerations in HRCT,” *Acad. Radiol.*, vol. 5, no. 8, pp. 539–546, Aug. 1998.
- [6] **J. M. Reinhardt**, A. J. Wang, T. P. Weldon, and W. E. Higgins, “Cue-based segmentation of 4D cardiac image sequences,” *Comp. Vision and Image Understanding*, vol. 77, no. 2, pp. 251–262, Feb. 2000.
- [7] S. Hu, E. A. Hoffman, and **J. M. Reinhardt**, “Automatic lung segmentation for accurate quantitation of volumetric X-ray CT images,” *IEEE Trans. Medical Imaging*, vol. 20, no. 6, pp. 490–498, Jun. 2001.
- [8] The National Emphysema Treatment Trial Research Group, “Patients at high risk of death after lung-volume-reduction surgery,” *New England J. Medicine*, vol. 345, no. 15, pp. 1–9, Oct. 2001.

- [9] L. Arbach, G. Fallouh, **J. M. Reinhardt**, and L. Bennett, “Distinguishing between malignant and nonmalignant breast masses from mammograms using artificial intelligence techniques,” *Bassel Al-Assad J. for Engineering Science*, vol. 16, pp. 103–121, Jul. 2002.
- [10] A. Kiraly, W. E. Higgins, G. McLennan, E. A. Hoffman, and **J. M. Reinhardt**, “3D human airway segmentation for clinical virtual bronchoscopy,” *Acad. Radiol.*, vol. 9, no. 10, pp. 1153–1168, Oct. 2002.
- [11] C. P. Rooney, M. Suter, G. McLennan, M. Donnelly, **J. M. Reinhardt**, A. Delsing, E. A. Hoffman, and J. Zabner, “Laser fluorescence bronchoscopy for detection of fluorescent reporter genes in airway epithelia,” *Gene Therapy*, vol. 9, no. 23, pp. 1639–1644, Dec. 2002.
- [12] A. Fishman, F. Martinez, K. Naunheim, S. Piantadosi, R. Wise, A. Ries, G. Weinmann, D. E. Wood, A. P. Fishman, B. A. Bozzarello, A. Al-Amin, M. Katz, C. Wheeler, E. Baker, P. Barnard, *et al.*, “A randomized trial comparing lung-volume-reduction surgery with medical therapy for severe emphysema,” *New England J. Medicine*, vol. 348, no. 21, pp. 2059–2073, May 2003, PMID: 12759479. Note: **J. M. Reinhardt** is author 428 of 448 on this manuscript.
- [13] D. Aykac, E. A. Hoffman, G. McLennan, and **J. M. Reinhardt**, “Segmentation and analysis of the human airway tree from three-dimensional X-ray CT images,” *IEEE Trans. Medical Imaging*, vol. 22, no. 8, pp. 940–950, Aug. 2003.
- [14] O. Saba, E. A. Hoffman, and **J. M. Reinhardt**, “Maximizing quantitative accuracy of lung airway lumen and wall measures obtained from X-ray CT imaging,” *J. Applied Physiology*, vol. 95, pp. 1063–1095, 2003.
- [15] E. A. Hoffman, **J. M. Reinhardt**, M. Sonka, B. A. Simon, J. Guo, O. Saba, D. Chon, S. Samrah, H. Shikata, J. Tschirren, K. Pálgyi, K. C. Beck, and G. McLennan, “Characterization of the interstitial lung diseases via density-based and texture-based analysis of computed tomography images of lung structure and function,” *Acad. Radiol.*, vol. 10, no. 10, pp. 1104–1118, Oct. 2003.
- [16] B. Li, G. E. Christensen, G. McLennan, E. A. Hoffman, and **J. M. Reinhardt**, “Establishing a normative atlas of the human lung: Inter-subject warping and registration of volumetric CT,” *Acad. Radiol.*, vol. 10, no. 3, pp. 255–265, Mar. 2003.
- [17] The National Emphysema Treatment Trial Research Group, “Safety and efficacy of median sternotomy versus video-assisted thoracic surgery for lung volume reduction surgery,” *J. Thorac. Cardiovasc. Surg.*, vol. 127, pp. 1350–1360, May 2004.
- [18] R. M. Kaplan, A. L. Ries, J. Reilly, Z. Mohsenifar, A. P. Fishman, B. A. Bozzarello, A. Al-Amin, M. Katz, C. Wheeler, E. Baker, P. Barnard, J. Carter, S. Chatziioannou, K. Conejo-Gonzales, J. Haddad, *et al.*, “Measurement of health-related quality of life in the national emphysema treatment trial,” *Chest*, vol. 126, no. 3, pp. 781–789, Sep. 2004, PMID: 15364757. Note: **J. M. Reinhardt** is author 426 of 446 on this manuscript.
- [19] M. Suter, J. Tschirren, **J. Reinhardt**, M. Sonka, E. Hoffman, W. Higgins, and G. McLennan, “Evaluation of the human airway with multi-detector X-ray computed tomography and optical imaging,” *Physiological Measurement*, vol. 25, no. 4, pp. 837–847, Aug. 2004.

- [20] M. H. Tawhai, P. Hunter, J. Tschirren, **J. M. Reinhardt**, G. McLennan, and E. A. Hoffman, "CT-based geometry analysis and finite element models of the human and ovine bronchial tree," *J. Applied Physiology*, vol. 97, no. 6, pp. 2310–2321, 2004.
- [21] E. A. Hoffman, A. V. Clough, G. E. Christensen, C.-L. Lin, G. McLennan, **J. M. Reinhardt**, B. A. Simon, M. Sonka, M. Tawhai, J. R. van Beek Edwin, and G. Wang, "The comprehensive imaging-based analysis of the lung: A forum for team science," *Acad. Radiol.*, vol. 11, no. 12, pp. 1370–1380, Dec. 2004.
- [22] O. I. Saba, D. Chon, K. Beck, G. McLennan, J. Sieren, **J. M. Reinhardt**, and E. A. Hoffman, "Static versus prospective gated non-breath hold volumetric MDCT imaging of the lungs," *Acad. Radiol.*, vol. 12, no. 11, pp. 1371–1384, Nov. 2005.
- [23] B. A. Simon, G. E. Christensen, D. A. Low, and **J. M. Reinhardt**, "Computed tomography studies of lung mechanics," *Proc Am Thorac Soc*, vol. 2, no. 6, pp. 517–521, 2005.
- [24] M. Suter, **J. M. Reinhardt**, P. Montague, P. Taft, J. Lee, J. Zabner, and G. McLennan, "Bronchoscopic imaging of the pulmonary mucosal vasculature responses to inflammatory mediators," *J. Biomed. Optics*, vol. 10, no. 3, p. 034013, May 2005.
- [25] M. Suter, G. McLennan, **J. M. Reinhardt**, D. Riker, and E. A. Hoffman, "Macro-optical color assessment of the pulmonary airways with subsequent three-dimensional multidetector-X-ray-computed-tomography assisted display," *J. Biomed. Optics*, vol. 10, no. 5, p. 051703, Sep. 2005.
- [26] S. Ukil and **J. M. Reinhardt**, "Smoothing lung segmentation surfaces in 3D X-ray CT images using anatomic guidance," *Acad. Radiol.*, vol. 12, no. 12, pp. 1502–1511, Dec. 2005.
- [27] W. M. Chatila, E. A. Hoffman, J. Gaughan, G. B. Robinswood, G. J. Criner, A. P. Fishman, B. A. Bozzarello, A. Al-Amin, M. Katz, C. Wheeler, E. Baker, P. Barnard, P. Cagle, J. Carter, S. Chatziioannou, *et al.*, "Advanced emphysema in African-American and white patients: Do differences exist?" *Chest*, vol. 130, pp. 108–118, Jul. 2006, PMID: 16840390. Note: **J. M. Reinhardt** is author 434 of 456 on this manuscript.
- [28] F. J. Martinez, G. Foster, J. L. Curtis, G. Criner, G. Weinmann, A. Fishman, M. M. DeCamp, J. Benditt, F. Sciurba, B. Make, Z. Mohsenifar, P. Diaz, E. Hoffman, R. Wise, A. P. Fishman, *et al.*, "Predictors of mortality in patients with emphysema and severe airflow obstruction," *Amer. J. Respiratory and Critical Care Medicine*, vol. 173, pp. 1326–1334, 2006. Note: **J. M. Reinhardt** is author 444 of 465 on this manuscript.
- [29] L. Zhang, E. Hoffman, and **J. M. Reinhardt**, "Lung lobe segmentation in volumetric X-ray CT images," *IEEE Trans. Medical Imaging*, vol. 25, no. 1, pp. 1–16, 2006.
- [30] L. A. Meinel, A. H. Stolpen, K. S. Berbaum, L. L. Fajardo, and **J. M. Reinhardt**, "Breast MRI lesion classification: Improved performance of human readers with a backpropagation neural network computer-aided diagnosis (CAD) system," *J. Magn. Res. Imaging*, vol. 25, no. 1, pp. 85–95, Jan. 2007.
- [31] B. D. Owen, G. E. Christensen, **J. M. Reinhardt**, and T. C. Ryken, "Rapid prototype patient-specific drill template for cervical pedicle screw placement," *Computer Aided Surgery*, vol. 12, no. 5, pp. 303–308, Sep. 2007.



- [32] M. Suter, **J. M. Reinhardt**, and G. McLennan, “Integrated CT/bronchoscopy in the central airways: Preliminary results,” *Acad. Radiol.*, vol. 15, no. 6, pp. 786–798, Jun. 2008.
- [33] M. K. Fuld, R. B. Easley, O. I. Saba, D. Chon, **J. M. Reinhardt**, E. A. Hoffman, and B. A. Simon, “CT measured regional specific volume change reflects regional specific ventilation in supine sheep,” *J. Applied Physiology*, vol. 104, no. 4, pp. 1177–1184, Apr. 2008.
- [34] **J. M. Reinhardt**, K. Ding, K. Cao, G. E. Christensen, E. A. Hoffman, and S. V. Bodas, “Registration-based estimates of local lung tissue expansion compared to xenon-CT measures of specific ventilation,” *Med. Imag. Analysis*, vol. 12, no. 6, pp. 752–763, Dec. 2008. DOI: 10.1016/j.media.2008.03.007.
- [35] B. Li, G. E. Christensen, G. McLennan, E. A. Hoffman, and **J. M. Reinhardt**, “Pulmonary CT image registration and warping for tracking tissue deformation during the respiratory cycle through 3-D consistent image registration,” *Medical Physics*, vol. 35, no. 12, pp. 5575–5583, 2008, 10.1118/1.3005633.
- [36] S. Ukil and **J. M. Reinhardt**, “Anatomy-guided lung lobar surface detection in X-ray CT images,” *IEEE Trans. Medical Imaging*, vol. 28, no. 2, pp. 202–214, 2009, PMID: 19188109. DOI: 10.1109/TMI.2008.929101.
- [37] T. C. Ryken, B. D. Owen, G. E. Christensen, and **J. M. Reinhardt**, “Image based drill-templates for cervical pedicle screw placement,” *J Neurosurg Spine*, vol. 10, no. 1, pp. 21–26, Jan. 2009. DOI: 10.3171/2008.9.SPI08229.
- [38] T. C. Ryken, B. D. Owen, G. E. Christensen, and **J. M. Reinhardt**, “Engineering patient-specific drill templates and bioabsorbable posterior cervical plates: a feasibility study,” *J Neurosurg Spine*, vol. 10, no. 2, pp. 129–132, Feb. 2009.
- [39] K. Ding, Y. Yin, K. Cao, G. E. Christensen, C.-L. Lin, E. A. Hoffman, and **J. M. Reinhardt**, “Evaluation of lobar biomechanics during respiration using image registration,” in *Medical Imaging Computing and Computer Assisted Intervention*, G.-Z. Yang, D. J. Hawkes, D. Rueckert, A. Noble, and C. Taylor, Eds., ser. Lecture Notes in Computer Science, vol. 5761, London: Springer-Verlag, Sep. 2009, pp. 739–746. DOI: 10.1007/978-3-642-04268-3\_91.
- [40] K. Cao, G. E. Christensen, K. Ding, and **J. M. Reinhardt**, “Intensity-and-landmark-driven, inverse consistent, B-spline registration and analysis for lung imagery,” in *Second International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., 2009, pp. 137–148.
- [41] P. Lo, B. van Ginneken, **J. M. Reinhardt**, and M. de Bruijne, “Extraction of airways from CT (EXACT’09),” in *Second International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., 2009, pp. 175–189.

- [42] T. E. Robinson, F. R. Long, P. Raman, P. Saha, M. J. Edmond, **J. M. Reinhardt**, R. Raman, and A. S. Brody, “An airway phantom to standardize CT acquisition in multi-center clinical trials,” *Acad. Radiol.*, vol. 16, no. 9, pp. 1134–1141, 2009. DOI: 10.1016/j.acra.2009.02.018.
- [43] J. Tschirren, T. Yavarna, and **J. M. Reinhardt**, “Airway segmentation framework for clinical environments,” in *Second International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., 2009, pp. 227–238.
- [44] E. A. Hoffman, R. Jiang, H. Baumhauer, M. A. Brooks, J. J. Carr, R. Detrano, **J. M. Reinhardt**, J. Rodriguez, K. Stukovsky, N. Wong, and R. G. Barr, “Reproducibility and validity of lung density measures from cardiac CT scans—The multi-ethnic study of atherosclerosis (MESA) lung study,” *Acad. Radiol.*, vol. 16, no. 6, pp. 689–699, Jun. 2009.
- [45] P. M. Kellen, D. L. Becker, **J. M. Reinhardt**, and D. J. Van Daele, “Computer-Assisted Assessment of Hyoid Bone Motion from Videofluoroscopic Swallow Studies,” *Dysphagia*, Oct. 2009, PMID: 19856024.
- [46] R. Benzo, M. H. Farrell, C. C. Chang, F. J. Martinez, R. Kaplan, J. Reilly, G. Criner, R. Wise, B. Make, J. Luketich, A. P. Fishman, F. C. Sciruba, A. P. Fishman, B. A. Bozzarello, A. Al-Amin, *et al.*, “Integrating health status and survival data: the palliative effect of lung volume reduction surgery,” *Amer. J. Respiratory and Critical Care Medicine*, vol. 180, pp. 239–246, Aug. 2009, PMID 19483114. Note: **J. M. Reinhardt** is author 442 of 463 on this manuscript.
- [47] G. J. Criner, P. Belt, A. L. Sternberg, Z. Mosenifar, B. J. Make, J. P. Utz, F. Sciruba, M. Katz, C. Wheeler, E. Baker, P. Barnard, S. Carter, S. Chatzioannou, K. Congejo-Gonzales, J. Haddad, *et al.*, “Effects of lung volume reduction surgery on gas exchange and breathing pattern during maximum exercise,” *Chest*, vol. 135, pp. 1268–1279, May 2009, PMID: 19420196. Note: **J. M. Reinhardt** is author 423 of 443 on this manuscript.
- [48] W. J. Kim, E. K. Silverman, E. Hoffman, G. J. Criner, Z. Mosenifar, F. C. Sciruba, B. J. Make, V. Carey, R. S. Estepar, A. Diaz, J. J. Reilly, F. J. Martinez, G. R. Washko, A. P. Fishman, B. A. Bozzarello, *et al.*, “CT metrics of airway disease and emphysema in severe COPD,” *Chest*, vol. 136, pp. 396–404, Aug. 2009, PMID: 19411295. Note: **J. M. Reinhardt** is author 463 of 484 on this manuscript.
- [49] J. C. Sieren, J. Weydert, E. Namati, J. Thiesse, J. P. Sieren, **J. M. Reinhardt**, E. A. Hoffman, and G. McLennan, “A process model for direct correlation between computed tomography and histopathology application in lung cancer,” *Acad. Radiol.*, vol. 17, pp. 169–180, Feb. 2010. DOI: 10.1016/j.acra.2009.09.006.
- [50] K. Ding, J. E. Bayouth, J. M. Buatti, G. E. Christensen, and **J. M. Reinhardt**, “4DCT-based measurement of changes in pulmonary function following a course of radiation therapy,” *Medical Physics*, vol. 37, no. 3, pp. 1261–1272, Mar. 2010. DOI: 10.1118/1.3312210.

- [51] M. D. Abramoff, **J. M. Reinhardt**, S. R. Russell, J. C. Folk, V. B. Mahajan, M. Niemeijer, and G. Quellec, “Automated early detection of diabetic retinopathy,” *Ophthalmology*, vol. 117, pp. 1147–1154, Jun. 2010. DOI: 10.1016/j.ophtha.2010.03.046.
- [52] S. Lee, **J. M. Reinhardt**, P. C. Cattin, and M. D. Abramoff, “Objective and expert-independent validation of retinal image registration algorithms by a projective imaging distortion model,” *Med. Imag. Analysis*, vol. 14, no. 4, pp. 539–549, Aug. 2010. DOI: 10.1016/j.media.2010.04.001.
- [53] L. Tang, T. E. Scheetz, D. A. Mackey, A. W. Hewitt, J. H. Fingert, Y. H. Kwon, G. Quellec, **J. M. Reinhardt**, and M. D. Abramoff, “Automated quantification of inherited phenotypes from color images: A twin study of the variability of optic nerve head shape,” *Invest Ophthalmol Vis Sci.*, vol. 51, pp. 5870–5877, Nov. 2010.
- [54] J. Thiesse, E. Namati, J. C. Sieren, A. R. Smith, **J. M. Reinhardt**, E. A. Hoffman, and G. McLennan, “Lung structure phenotype variation in inbred mouse strains revealed through in vivo micro-CT imaging,” *J. Applied Physiology*, vol. 109, pp. 1960–1968, Dec. 2010. DOI: 10.1152/jappphysiol.01322.2009.
- [55] G. R. Washko, F. J. Martinez, E. A. Hoffman, S. H. Loring, R. S. Estepar, A. A. Diaz, F. C. Sciruba, E. K. Silverman, M. K. Han, M. Decamp, J. J. Reilly, A. P. Fishman, B. A. Bozzarello, A. Al-Amin, M. Katz, *et al.*, “Physiological and computed tomographic predictors of outcome from lung volume reduction surgery,” *Amer. J. Respiratory and Critical Care Medicine*, vol. 181, pp. 494–500, Mar. 2010. Note: **J. M. Reinhardt** is author 440 of 462 on this manuscript.
- [56] M. K. Han, R. Wise, J. Mumford, F. Sciruba, G. J. Criner, J. L. Curtis, S. Murray, A. Sternberg, G. Weinman, E. Kazerooni, A. P. Fishman, B. Make, E. A. Hoffman, Z. Mosenifar, F. J. Martinez, *et al.*, “Prevalence and clinical correlates of bronchoreversibility in severe emphysema,” *European Respiratory J.*, vol. 35, pp. 1048–1056, May 2010. Note: **J. M. Reinhardt** is author 444 of 466 on this manuscript.
- [57] Y. Yin, E. A. Hoffman, K. Ding, **J. M. Reinhardt**, and C.-L. Lin, “A cubic B-spline-based hybrid registration of lung CT images for a dynamic airway geometric model with large deformation,” *Phys. Med. Biol.*, vol. 56, pp. 203–218, Jan. 2011. DOI: 10.1088/0031-9155/56/1/013.
- [58] X. Xu, M. Niemeijer, Q. Song, M. Sonka, M. K. Garvin, **J. M. Reinhardt**, and M. D. Abramoff, “Vessel Boundary Delineation on Fundus Images using Graph-Based Approach,” *IEEE Trans. Medical Imaging*, vol. 30, no. 6, pp. 1184–1191, Jan. 2011.
- [59] R. E. Amelon, K. Cao, K. Ding, G. E. Christensen, **J. M. Reinhardt**, and M. L. Raghavan, “Three-dimensional characterization of regional lung deformation,” *J Biomechanics*, vol. 44, pp. 2489–2495, Sep. 2011.
- [60] L. M. Gabe, K. M. Baker, E. J. R. van Beek, G. W. Hunninghake, **J. M. Reinhardt**, and E. A. Hoffman, “Effect of segmental bronchoalveolar lavage on quantitative computed tomography of the lung,” *Acad. Radiol.*, vol. 18, pp. 876–884, Jul. 2011.

- [61] K. Murphy, B. van Ginneken, **J. M. Reinhardt**, S. Kabus, K. Ding, X. Deng, K. Cao, K. Du, G. E. Christensen, V. Garcia, T. Vercauteren, N. Ayache, O. Commowick, G. Malandain, B. Glocker, *et al.*, “Evaluation of registration methods on thoracic CT: the EMPIRE10 challenge,” *IEEE Trans. Medical Imaging*, vol. 30, pp. 1901–1920, Nov. 2011.
- [62] M. A. Puhan, D. Chandra, Z. Mosenifar, A. Ries, B. Make, N. N. Hansel, R. A. Wise, F. Sciruba, A. P. Fishman, B. A. Bozzarello, A. Al-Amin, M. Katz, C. Wheeler, E. Baker, P. Barnard, *et al.*, “The minimal important difference of exercise tests in severe COPD,” *European Respiratory J.*, vol. 37, pp. 784–790, Apr. 2011. Note: **J. M. Reinhardt** is author 334 of 455 on this manuscript.
- [63] K. Ding, K. Cao, M. K. Fuld, K. Du, G. E. Christensen, E. A. Hoffman, and **J. M. Reinhardt**, “Comparison of image registration based measures of regional lung ventilation from dynamic spiral CT with Xe-CT,” *Medical Physics*, vol. 39, no. 8, pp. 5084–5098, 2012. DOI: 10.1118/1.4736808.
- [64] K. Du, J. E. Bayouth, K. Cao, G. E. Christensen, K. Ding, and **J. M. Reinhardt**, “Reproducibility of registration-based measures of lung tissue expansion,” *Medical Physics*, vol. 39, no. 3, pp. 1595–1608, Mar. 2012. DOI: <http://link.aip.org/link/doi/10.1118/1.3685589>.
- [65] S. Sommerfeld Ross, **J. M. Reinhardt**, and J. Fiegel, “Enhanced analysis of bacteria susceptibility in connected biofilms,” *J. Microbiol. Methods*, vol. 90, no. 1, pp. 9–14, Jul. 2012.
- [66] V. S. Joshi, R. J. Maude, **J. M. Reinhardt**, L. Tang, M. K. Garvin, A. A. Sayeed, A. Ghose, M. U. Hassan, and M. A. Abramoff, “Automated detection of malarial retinopathy associated retinal hemorrhages,” *Invest Ophthalmol Vis Sci.*, vol. 53, no. 10, pp. 6582–6588, Sep. 2012, PMID: 22915035.
- [67] P. Lo, B. van Ginneken, **J. M. Reinhardt**, T. Yavarna, P. de Jong, B. Irving, C. Fetita, M. Ortner, R. Pinho, J. Sijbers, M. Feuerstein, A. Fabijanska, C. Bauer, R. Beichel, C. Mendoza, *et al.*, “Extraction of airways from CT (EXACT’09),” *IEEE Trans. Medical Imaging*, vol. 31, no. 11, pp. 2093–2107, Nov. 2012. DOI: 10.1109/TMI.2012.2209674.
- [68] B. Li, G. E. Christensen, E. A. Hoffman, G. McLennan, and **J. M. Reinhardt**, “Establishing a normative atlas of the human lung: Computing the average transformation and atlas construction,” *Acad. Radiol.*, vol. 19, no. 11, pp. 1368–1381, Nov. 2012, PMID: 22951110. DOI: 10.1016/j.acra.2012.04.025.
- [69] K. Cao, G. E. Christensen, K. Ding, K. Du, M. L. Raghavan, R. E. Amelon, K. M. Baker, E. A. Hoffman, and **J. M. Reinhardt**, “Tracking regional tissue volume and function change in lung using image registration,” *Int. J. Biomed Imaging*, vol. 2012, p. 956 248, 2012, PMID: 23118740. DOI: 10.1155/2012/956248.
- [70] K. Cao, K. Ding, **J. M. Reinhardt**, and G. E. Christensen, “Improving Intensity-Based Lung CT Registration Accuracy Utilizing Vascular Information,” *Int. J. Biomed Imaging*, vol. 2012, p. 285 136, 2012, PMID: 23251141. [Online]. Available: <http://www.hindawi.com/journals/ijbi/2012/285136/>.

- [71] X. Xu, **J. M. Reinhardt**, Q. Hu, B. Bakall, P. S. Tluczek, G. Bertelsen, and M. D. Abramoff, “Retinal vessel width measurement at branchings using an improved electric field theory-based graph approach,” *PLoS ONE*, vol. 7, no. 11, e49668, 2012, PMID: 23209588.
- [72] D. S. Kacmarynski, R. Amendola, **J. M. Reinhardt**, and R. J. Smith, “Flexible models for planning repair of complex tracheal anomalies,” *Laryngoscope*, vol. 122 Suppl 4, S77, Dec. 2012, PMID: 23254611.
- [73] S. Bodduluri, J. D. Newell, E. A. Hoffman, and **J. M. Reinhardt**, “Registration-based lung mechanical analysis of chronic obstructive pulmonary disease (COPD) using a supervised machine learning framework,” *Acad. Radiol.*, vol. 20, no. 5, pp. 527–536, May 2013, PMID: 23570934.
- [74] L. Tang, M. Niemeijer, **J. M. Reinhardt**, M. K. Garvin, and M. D. Abramoff, “Splat feature classification with application to retinal hemorrhage detection in fundus images,” *IEEE Trans. Medical Imaging*, vol. 32, no. 2, pp. 364–375, Feb. 2013, PMID: 23193310.
- [75] K. Du, J. E. Bayouth, K. Ding, G. E. Christensen, K. Cao, and **J. M. Reinhardt**, “Reproducibility of intensity-based estimates of lung ventilation,” *Medical Physics*, vol. 40, no. 6, p. 063 504, May 2013, PMID: 23718615. DOI: 10.1118/1.4805106.
- [76] K. Du, **J. M. Reinhardt**, G. E. Christensen, K. Ding, and J. E. Bayouth, “Respiratory effort correction strategies to improve the reproducibility of lung expansion measurements,” *Medical Physics*, vol. 40, no. 12, p. 123 504, 2013. DOI: 10.1118/1.4829519. [Online]. Available: <http://scitation.aip.org/content/aapm/journal/medphys/40/12/10.1118/1.4829519>.
- [77] R. J. Adam, A. S. Michalski, C. Bauer, M. H. Abou Alaiwa, T. J. Gross, M. S. Awadalla, D. C. Bouzek, N. D. Gansemer, P. J. Taft, M. J. Hoegger, A. Diwakar, M. Ochs, **J. M. Reinhardt**, E. A. Hoffman, R. R. Beichel, *et al.*, “Air trapping and airflow obstruction in newborn cystic fibrosis piglets,” *Amer. J. Respiratory and Critical Care Medicine*, vol. 188, no. 12, pp. 1434–1441, 2013, PMID: 24168209.
- [78] S. Sommerfeld Ross, M. H. Tu, M. L. Falsetta, M. R. Ketterer, M. R. Kiedrowski, A. R. Horswill, M. A. Apicella, **J. M. Reinhardt**, and J. Fiegel, “Quantification of confocal images of biofilms grown on irregular surfaces,” *J. Microbiol. Methods*, vol. 100, pp. 111–120, May 2014, PMID: 24632515.
- [79] V. S. Joshi, **J. M. Reinhardt**, M. K. Garvin, and M. D. Abramoff, “Automated method for identification and artery-venous classification of vessel trees in retinal vessel networks,” *PLoS ONE*, vol. 9, no. 2, e88061, 2014, PMID: 24533066.
- [80] R. E. Amelon, K. Cao, **J. M. Reinhardt**, G. E. Christensen, and M. L. Raghavan, “A measure for characterizing sliding on lung boundaries,” *Ann Biomed Eng*, vol. 42, no. 3, pp. 642–650, Mar. 2014, PMID: 24114112.
- [81] R. L. Amendola, **J. M. Reinhardt**, M. B. Zimmerman, Y. Sato, H. R. Diggelmann, and D. S. Kacmarynski, “Development of a preliminary pediatric tracheal growth model from magnetic resonance images,” *Laryngoscope*, vol. 124, no. 8, pp. 1947–1951, Aug. 2014, PMID: 24307560.

- [82] S. P. Bhatt, S. Bodduluri, J. D. Newell, E. A. Hoffman, J. C. Sieren, M. K. Han, M. T. Dransfield, and **J. M. Reinhardt**, “CT-derived Biomechanical Metrics Improve Agreement Between Spirometry and Emphysema,” *Acad. Radiol.*, vol. 23, no. 10, pp. 1255–1263, Apr. 2016, PMID: 27055745.
- [83] G. G. Zhang, K. Latifi, K. Du, **J. M. Reinhardt**, G. E. Christensen, K. Ding, V. Feygelman, and E. G. Moros, “Evaluation of the  $\Delta V$  4D CT ventilation calculation method using in vivo xenon CT ventilation data and comparison to other methods,” *J Appl Clin Med Phys*, vol. 17, no. 2, p. 5985, 2016, PMID: 27074479.
- [84] S. Bodduluri, S. P. Bhatt, E. A. Hoffman, J. D. Newell, C. H. Martinez, M. T. Dransfield, M. K. Han, and **J. M. Reinhardt**, “Biomechanical CT metrics are associated with patient outcomes in COPD,” *Thorax*, vol. 72, no. 5, pp. 409–414, May 2017, PMID: 28044005. [Online]. Available: <http://thoraxbeta.bmj.com/content/early/2017/01/02/thoraxjnl-2016-209544>.
- [85] S. Bodduluri, S. P. Bhatt, and **J. M. Reinhardt**, “Computed tomography image matching in chronic obstructive pulmonary disease,” *Critical Reviews in Biomedical Engineering*, vol. 44, no. 6, pp. 411–425, 2016, PMID: 29431089, ISSN: 0278-940X. DOI: 10.1615/CritRevBiomedEng.2017021299.
- [86] S. P. Bhatt, S. Bodduluri, E. A. Hoffman, J. D. Newell, J. C. Sieren, M. T. Dransfield, and **J. M. Reinhardt**, “Computed Tomography Measure of Lung At-risk and Lung Function Decline in Chronic Obstructive Pulmonary Disease,” *Amer. J. Respiratory and Critical Care Medicine*, May 2017, PMID: 28481639. DOI: 10.1164/rccm.201701-00500C.
- [87] S. Bodduluri, **J. M. Reinhardt**, E. A. Hoffman, J. D. Newell, H. Nath, M. T. Dransfield, and S. P. Bhatt, “Signs of Gas Trapping in Normal Lung Density Regions in Smokers,” *Amer. J. Respiratory and Critical Care Medicine*, Jul. 2017, PMID: 28707983. DOI: 10.1164/rccm.201705-08550C.
- [88] S. Bodduluri, **J. M. Reinhardt**, E. A. Hoffman, J. D. Newell, and S. P. Bhatt, “Recent Advances in CT Imaging in Chronic Obstructive Pulmonary Disease,” *Ann Am Thorac Soc*, Aug. 2017, PMID: 28812906. DOI: 10.1513/AnnalsATS.201705-377FR.
- [89] S. E. Gerard, T. J. Patton, G. E. Christensen, J. E. Bayouth, and **J. M. Reinhardt**, “FissureNet: A deep learning approach for pulmonary fissure detection in CT images,” *IEEE Trans. Medical Imaging*, vol. 38, no. 1, pp. 156–166, 2019, PMID: 30106711. DOI: 10.1109/TMI.2018.2858202.
- [90] S. Bodduluri, A. S. K. Puliyaokote, S. E. Gerard, **J. M. Reinhardt**, E. A. Hoffman, J. D. Newell, H. P. Nath, M. K. Han, G. R. Washko, R. San Jose Estepar, M. T. Dransfield, S. P. Bhatt, and The COPDGene Investigators, “Airway fractal dimension predicts respiratory morbidity and mortality in COPD,” *J. Clin. Invest.*, Oct. 2018, PMID: 30256767. DOI: 10.1172/JCI120693.
- [91] T. J. Patton, S. E. Gerard, W. Shao, G. E. Christensen, **J. M. Reinhardt**, and J. E. Bayouth, “Quantifying ventilation change due to radiation therapy using 4DCT Jacobian calculations,” *Medical Physics*, vol. 45, no. 10, pp. 4483–4492, Oct. 2018, PMID: 30047588. DOI: 10.1002/mp.13105.

- [92] J. Kipritidis, B. A. Tahir, G. Cazoulat, M. S. Hofman, S. Siva, J. Callahan, N. Hardcastle, T. Yamamoto, G. E. Christensen, **J. M. Reinhardt**, N. Kadoya, T. J. Patton, S. E. Gerard, I. Duarte, B. Archibald-Heeren, *et al.*, “The VAMPIRE Challenge: A Multi-Institutional Validation Study of CT Ventilation Imaging,” *Medical Physics*, vol. 46, no. 3, pp. 1198–1217, Dec. 2018, PMID: 30575051. DOI: 10.1002/mp.13346.
- [93] J. Niu, M. Cai, Y. Shi, S. Ren, W. Xu, W. Gao, Z. Luo, and **J. M. Reinhardt**, “A Novel Method for Automatic Identification of Breathing State,” *Sci Rep*, vol. 9, no. 1, p. 103, Jan. 2019, PMID: 30643176. DOI: 10.1038/s41598-018-36454-5.
- [94] W. Shao, T. J. Patton, S. E. Gerard, Y. Pan, **J. M. Reinhardt**, O. C. Durumeric, J. E. Bayouth, and G. E. Christensen, “N-Phase Local Expansion Ratio for Characterizing Out-of-Phase Lung Ventilation,” *IEEE Trans. Medical Imaging*, vol. 39, no. 6, pp. 2025–2034, 2019, PMID: 31899418.
- [95] K. E. Lowe, E. A. Regan, A. Anzueto, E. Austin, J. H. M. Austin, T. H. Beaty, P. V. Benos, C. J. Benway, S. P. Bhatt, E. R. Bleecker, S. Bodduluri, J. Bon, A. M. Boriek, A. R. Boueiz, R. P. Bowler, *et al.*, “COPDGene<sup>®</sup> 2019: Redefining the Diagnosis of Chronic Obstructive Pulmonary Disease,” *Chronic Obstr Pulm Dis*, vol. 6, no. 5, pp. 384–399, Nov. 2019, PMID: 31710793. Note: **J. M. Reinhardt** is author 83 of 112 on this manuscript.
- [96] J. Herrmann, S. E. Gerard, W. Shao, M. L. Hawley, **J. M. Reinhardt**, G. E. Christensen, E. A. Hoffman, and D. W. Kaczka, “Quantifying regional lung deformation using four-dimensional computed tomography,” *Frontiers in Physiology*, vol. 11, p. 14, 2020.
- [97] S. E. Gerard, J. Herrmann, D. W. Kaczka, G. Musch, A. Fernandez-Bustamante, and **J. M. Reinhardt**, “Multi-Resolution convolutional neural networks for fully automated segmentation of acutely injured lungs in multiple species,” *Med. Imag. Analysis*, vol. 60, p. 101592, 2020.
- [98] E. M. Wallat, M. J. Flakus, A. E. Wuschner, W. Shao, G. E. Christensen, **J. M. Reinhardt**, A. M. Baschnagel, and J. E. Bayouth, “Modeling the impact of out-of-phase ventilation on normal lung tissue response to radiation dose,” *Medical Physics*, Mar. 2020, PMID: 32187683.
- [99] W. Shao, T. J. Patton, S. E. Gerard, Y. Pan, **J. M. Reinhardt**, O. C. Durumeric, J. E. Bayouth, and G. E. Christensen, “N-Phase Local Expansion Ratio for Characterizing Out-of-Phase Lung Ventilation,” *IEEE Trans. Medical Imaging*, vol. 39, no. 6, pp. 2025–2034, Jun. 2020, PMID: 31899418.
- [100] S. Bodduluri, A. Kizhakke Puliyakote, A. Nakhmani, J. P. Charbonnier, **J. M. Reinhardt**, and S. P. Bhatt, “CT-based airway surface area to volume ratio for phenotyping airway remodeling in chronic obstructive pulmonary disease,” *Amer. J. Respiratory and Critical Care Medicine*, Aug. 2020, PMID: 32755486.
- [101] S. Bodduluri, A. Nakhmani, **J. M. Reinhardt**, C. G. Wilson, M. L. McDonald, R. Rudraraju, B. C. Jaeger, N. R. Bhakta, P. J. Castaldi, F. C. Scurba, C. Zhang, P. V. Bangalore, and S. P. Bhatt, “Deep neural network analyses of spirometry for structural phenotyping of chronic obstructive pulmonary disease,” *JCI Insight*, vol. 5, no. 13, Jul. 2020, PMID: 32554922.

- [102] S. E. Gerard, J. Herrmann, Y. Xin, K. T. Martin, E. Rezoagli, D. Ippolito, G. Bellani, M. Cereda, J. Guo, E. A. Hoffman, D. W. Kaczka, and **J. M. Reinhardt**, “CT image segmentation for inflamed and fibrotic lungs using a multi-resolution convolutional neural network,” *Scientific Reports*, vol. 11, no. 1, p. 1455, 2021. DOI: 10.1038/s41598-020-80936-4. [Online]. Available: <https://doi.org/10.1038/s41598-020-80936-4>.

#### IV. Rigorously Reviewed Conference Articles

- [1] **J. M. Reinhardt**, J. Guo, L. Zhang, D. Bilgen, S. Hu, R. Uppaluri, R. M. Long, O. I. Saba, G. McLennan, M. Sonka, and E. A. Hoffman, “Integrated system for objective assessment of global and regional lung structure,” in *Medical Imaging Computing and Computer Assisted Intervention*, W. J. Niessen and M. A. Viergever, Eds., ser. Lecture Notes in Computer Science, vol. 2208, Utrecht: Springer-Verlag, Oct. 2001, pp. 1384–1385.
- [2] H. Kitaoka, Y. Park, J. Tschirren, **J. M. Reinhardt**, M. Sonka, G. McLennan, and E. A. Hoffman, “Automated nomenclature labeling of the bronchial tree in 3D-CT lung images,” in *Medical Imaging Computing and Computer Assisted Intervention*, T. Dohi and R. Kikinis, Eds., ser. Lecture Notes in Computer Science, vol. 2489, Utrecht: Springer-Verlag, Oct. 2002, pp. 1–11.
- [3] J. Tschirren, K. Palágyi, **J. M. Reinhardt**, E. A. Hoffman, and M. Sonka, “Segmentation, skeletonization, and branchpoint matching—A fully automated quantitative evaluation of human intrathoracic airway trees,” in *Medical Imaging Computing and Computer Assisted Intervention*, T. Dohi and R. Kikinis, Eds., ser. Lecture Notes in Computer Science, vol. 2489, Utrecht: Springer-Verlag, Oct. 2002, pp. 12–19.
- [4] **J. M. Reinhardt**, G. E. Christensen, E. A. Hoffman, K. Ding, and K. Cao, “Registration-derived estimates of local lung expansion as surrogates for regional ventilation,” in *Information Processing in Medical Imaging*, N. Karssemeijer and B. Lelieveldt, Eds., ser. Lecture Notes in Computer Science, vol. 4584, Utrecht: Springer-Verlag, Jul. 2007, pp. 763–774.
- [5] K. Ding, K. Cao, G. E. Christensen, M. L. Raghavan, E. A. Hoffman, and **J. M. Reinhardt**, “Registration-based lung tissue mechanics assessment during tidal breathing,” in *First International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, K. Mori, and **J. Reinhardt**, Eds., 2008, pp. 63–72.
- [6] J. Guo, M. K. Fuld, S. K. Alford, **J. M. Reinhardt**, and E. A. Hoffman, “Pulmonary Analysis Software Suite 9.0: Integrating quantitative measures of function with structural analyses,” in *First International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, K. Mori, and **J. Reinhardt**, Eds., 2008, pp. 283–292.
- [7] K. Cao, G. E. Christensen, K. Ding, and **J. M. Reinhardt**, “Intensity-and-landmark-driven, inverse consistent, B-spline registration and analysis for lung imagery,” in *Second International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., 2009, pp. 137–148.



- [8] P. Lo, B. van Ginneken, **J. M. Reinhardt**, and M. de Bruijne, “Extraction of airways from CT (EXACT’09),” in *Second International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., 2009, pp. 175–189.
- [9] J. Tschirren, T. Yavarna, and **J. M. Reinhardt**, “Airway segmentation framework for clinical environments,” in *Second International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., 2009, pp. 227–238.
- [10] K. Ding, Y. Yin, K. Cao, G. E. Christensen, C.-L. Lin, E. A. Hoffman, and **J. M. Reinhardt**, “Evaluation of lobar biomechanics during respiration using image registration,” in *Medical Imaging Computing and Computer Assisted Intervention*, G.-Z. Yang, D. J. Hawkes, D. Rueckert, A. Noble, and C. Taylor, Eds., ser. Lecture Notes in Computer Science, vol. 5761, London: Springer-Verlag, Sep. 2009, pp. 739–746. DOI: 10.1007/978-3-642-04268-3\_91.
- [11] X. Artaechevarria, D. Perez-Martin, **J. M. Reinhardt**, A. Munoz-Barrutia, and C. Ortiz-de-Solarzano, “Automated quantitative analysis of a mouse model of chronic pulmonary inflammation using micro X-ray computed tomography,” in *Second International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, A. Kiraly, J. M. Kuhnigk, C. Lorenz, J. R. McClelland, K. Mori, A. Reeves, and **J. M. Reinhardt**, Eds., 2009, pp. 115–124.
- [12] K. Cao, K. Ding, G. E. Christensen, M. L. Raghavan, R. E. Amelon, and **J. M. Reinhardt**, “Unifying vascular information in intensity-based nonrigid lung CT registration,” in *4<sup>th</sup> International Workshop on Biomedical Image Registration*, ser. LCNS 6204, Springer, Jul. 2010, pp. 1–12.
- [13] K. Ding, K. Cao, R. E. Amelon, M. L. Raghavan, G. E. Christensen, and **J. M. Reinhardt**, “Comparison of intensity- and Jacobian-based estimates of lung regional ventilation,” in *Third International Workshop on Pulmonary Image Analysis*, M. Brown, M. de Bruijne, B. van Ginneken, K. Ding, A. Kiraly, J.-M. Kuhnigk, J. McClelland, K. Mori, and **J. M. Reinhardt**, Eds., Beijing, 2010, pp. 49–60.
- [14] K. Cao, K. Du, K. Ding, **J. M. Reinhardt**, and G. E. Christensen, “Regularized nonrigid registration of lung CT images by preserving tissue volume and vesselness measure,” in *Medical Image Analysis for the Clinic — A Grand Challenge*, B. van Ginneken, K. Murphy, T. Heimann, V. Pekar, and X. Deng, Eds., Beijing, 2010, pp. 43–54.
- [15] K. Murphy, B. van Ginneken, **J. M. Reinhardt**, S. Kabus, K. Ding, X. Deng, and J. Pluim, “Evaluation of methods for pulmonary image registration: The EMPIRE10 study,” in *Medical Image Analysis for the Clinic — A Grand Challenge*, B. van Ginneken, K. Murphy, T. Heimann, V. Pekar, and X. Deng, Eds., Beijing, 2010, pp. 11–22.

- [16] A. Feragen, P. Lo, V. Gorbunova, M. Nielsen, A. Dirksen, **J. M. Reinhardt**, F. Lauze, and M. de Bruijne, “An airway tree-shape model for geodesic airway branch labeling,” in *Third MICCAI Workshop on Mathematical Foundations of Computational Anatomy*, X. Pennec, S. Joshi, and M. Nielsen, Eds., 2011.
- [17] V. Joshi, M. K. Garvin, **J. M. Reinhardt**, and M. D. Abramoff, “Identification and reconnection of interrupted vessels in retinal vessel segmentation,” in *Biomedical Imaging: From Nano to Macro, ISBI 2011. 8th IEEE International Symposium on Biomedical Imaging*, vol. 1658, 2011.
- [18] X. Xu, M. Niemeijer, Q. Song, M. K. Gavin, **J. M. Reinhardt**, and M. D. Abramoff, “Retinal vessel width measurement based on a graph-theoretic method,” in *Biomedical Imaging: From Nano to Macro, ISBI 2011. 8th IEEE International Symposium on Biomedical Imaging*, vol. 1658, 2011.
- [19] K. Ding, W. Miller, K. Cao, G. E. Christensen, **J. M. Reinhardt**, S. Benedict, B. Libby, and K. Sheng, “Quantification of regional lung ventilation from tagged hyperpolarized helium-3 MRI,” in *Biomedical Imaging: From Nano to Macro, ISBI 2011. 8th IEEE International Symposium on Biomedical Imaging*, vol. 1658, 2011, pp. 1074–1077.
- [20] K. Du, K. Ding, K. Cao, J. E. Bayouth, G. E. Christensen, and **J. M. Reinhardt**, “Registration-based measurement of regional expiration volume ratio using dynamic 4DCT imaging,” in *Biomedical Imaging: From Nano to Macro, ISBI 2011. 8th IEEE International Symposium on Biomedical Imaging*, vol. 1658, 2011.
- [21] S. G. Yeary, G. E. Christensen, J. E. Bayouth, S. Bodduluri, Y. Pan, J. Guo, K. Du, J. H. Song, B. Zhao, I. Oguz, and **J. M. Reinhardt**, “4D lung CT segmentation for radiation therapy applications,” in *ICART: Imaging and Computer Assistance in Radiation Therapy*, 2015, pp. 50–57.
- [22] Y. Pan, G. E. Christensen, O. C. Durumeric, S. E. Gerard, **J. M. Reinhardt**, and G. D. Hugo, “Current- and varifold-based registration of lung vessel and airway trees,” in *7<sup>th</sup> International Workshop on Biomedical Image Registration*, Jun. 2016.
- [23] B. Zhao, G. E. Christensen, J. Hyun Song, Y. Pan, S. E. Gerard, **J. M. Reinhardt**, K. Du, T. Patton, J. E. Bayouth, and G. D. Hugo, “Tissue-volume preserving deformable image registration for 4DCT pulmonary images,” in *7<sup>th</sup> International Workshop on Biomedical Image Registration*, Jun. 2016.
- [24] S. E. Gerard, H. J. Johnson, J. E. Bayouth, G. E. Christensen, K. Du, J. Guo, and **J. M. Reinhardt**, “Alpha shapes for lung segmentation in the presence of large tumors,” in *6<sup>th</sup> International Workshop on Pulmonary Image Analysis*, 2016, pp. 9–17.
- [25] S. E. Gerard, J. Herrmann, D. W. Kaczka, and **J. M. Reinhardt**, “Transfer learning for segmentation of injured lungs using coarse-to-fine convolutional neural networks,” in *Image Analysis for Moving Organ, Breast, and Thoracic Images*, Springer, 2018, pp. 191–201.

- [26] W. Shao, S. E. Gerard, Y. Pan, T. J. Patton, **J. M. Reinhardt**, O. C. Durumeric, J. E. Bayouth, and G. E. Christensen, “Sensitivity analysis of Jacobian determinant used in treatment planning for lung cancer,” in *Proc. SPIE Conf. Medical Imaging*, SPIE, 2018.
- [27] S. E. Gerard and **J. M. Reinhardt**, “Pulmonary lobe segmentation using a sequence of convolutional neural networks for marginal learning,” in *2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019)*, 2019, pp. 1207–1211. DOI: 10.1109/ISBI.2019.8759212.
- [28] S. E. Gerard, **J. M. Reinhardt**, G. E. Christensen, and R. S. J. Estépar, “Estimating local tissue expansion in thoracic computed tomography images using convolutional neural networks,” in *2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI)*, IEEE, 2020, pp. 1856–1860.
- [29] Y. Pan, G. E. Christensen, O. C. Durumeric, S. E. Gerard, S. P. Bhatt, R. G. Barr, E. A. Hoffman, and **J. M. Reinhardt**, “Assessment of lung biomechanics in COPD using image registration,” in *2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI)*, IEEE, 2020, pp. 1891–1895.
- [30] Z. W. Althof, S. E. Gerard, Y. Pan, G. E. Christensen, E. A. Hoffman, and **J. M. Reinhardt**, “Automatic quantification of pulmonary fissure integrity: A repeatability analysis,” in *2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI)*, IEEE, 2020, pp. 581–585.
- [31] P. Wilhelm, **J. M. Reinhardt**, and D. Van Daele, “A deep learning approach to video fluoroscopic swallowing exam classification,” in *2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI 2020)*, In press, 2020.
- [32] M. F. A. Chaudhary, Y. Pan, D. Wang, S. Bodduluri, S. P. Bhatt, A. P. Comellas, E. A. Hoffman, G. E. Christensen, and **J. M. Reinhardt**, “Registration-invariant biomechanical features for disease staging of COPD in SPIROMICS,” in *2<sup>nd</sup> International Workshop on Thoracic Image Analysis*, 2020, pp. 143–154.

## V. Conference Papers and Less Rigorously Reviewed Articles

- [1] **J. M. Reinhardt** and W. E. Higgins, “Toward efficient morphological shape representation,” in *Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing*, vol. V, Minneapolis, MN, Apr. 1993, pp. 125–128.
- [2] **J. M. Reinhardt** and W. E. Higgins, “Flexible search-based approach for morphological shape decomposition,” in *Proc. SPIE Conf. Visual Comm.*, vol. 2094, Boston, MA, Nov. 1993, pp. 1424–1435.
- [3] W. E. Higgins, W. L. Sharp, M. W. Hansen, and **J. M. Reinhardt**, “A graphical user interface system for 3D medical image analysis,” in *Proc. SPIE Conf. Medical Imaging*, vol. 2164, Newport Beach, CA, Feb. 1994, pp. 95–106.
- [4] W. E. Higgins, **J. M. Reinhardt**, and W. L. Sharp, “Semi-automatic construction of 3D medical image-segmentation processes,” in *Proc. SPIE Conf. Visual. in Biomed. Comp.*, vol. 2359, Rochester, MN, Oct. 1994, pp. 59–71.

- [5] **J. M. Reinhardt** and W. E. Higgins, "Shape representation: Comparison between the morphological skeleton and morphological shape decomposition," in *Proc. IEEE Int. Conf. Image Processing*, vol. I, Austin, TX, Nov. 1994, pp. 91–95.
- [6] **J. M. Reinhardt** and W. E. Higgins, "Automatic generation of image-segmentation processes," in *Proc. IEEE Int. Conf. Image Processing*, vol. III, Austin, TX, Nov. 1994, pp. 791–795.
- [7] **J. M. Reinhardt** and W. E. Higgins, "Strategy for shape-based image analysis," in *Proc. IEEE Int. Conf. Image Processing*, vol. I, Washington, DC, Oct. 1995, pp. 502–505.
- [8] N. D. D'Souza, **J. M. Reinhardt**, and E. A. Hoffman, "ASAP: Interactive quantification of 2D airway geometry," in *Proc. SPIE Conf. Medical Imaging*, vol. 2709, Newport Beach, CA, Feb. 1996, pp. 180–196.
- [9] W. E. Higgins, A. J. Wang, and **J. M. Reinhardt**, "Semi-automatic 4D analysis of cardiac image sequences," in *Proc. SPIE Conf. Medical Imaging*, vol. 2709, Newport Beach, CA, Feb. 1996, pp. 359–372.
- [10] R. A. Chiplunkar, **J. M. Reinhardt**, and E. A. Hoffman, "Segmentation and quantification of the primary human airway tree from 3-D X-ray CT," in *Proc. SPIE Conf. Medical Imaging*, vol. 3033, Newport Beach, CA, Feb. 1997, pp. 403–414.
- [11] E. A. Hoffman, **J. M. Reinhardt**, J. K. Tajik, and B. Q. Tran, "Physiologic assessment of the lung via X-ray CT," in *Proc. SPIE Conf. Medical Imaging*, vol. 3033, Newport Beach, CA, Feb. 1997.
- [12] **J. M. Reinhardt**, W. Park, E. A. Hoffman, and M. Sonka, "Intrathoracic airway wall detection using graph search with CT scanner PSF information," in *Proc. SPIE Conf. Medical Imaging*, vol. 3033, Newport Beach, CA, Feb. 1997, pp. 93–101.
- [13] **J. M. Reinhardt**, S. A. Raab, N. D. D'Souza, and E. A. Hoffman, "Intra-thoracic airway measurement: *Ex vivo* validation," in *Proc. SPIE Conf. Medical Imaging*, vol. 3033, Newport Beach, CA, Feb. 1997, pp. 69–80.
- [14] R. D. Swift, W. E. Higgins, E. A. Hoffman, G. McLennan, and **J. M. Reinhardt**, "Automatic axis generation for 3D virtual-bronchoscopic image assessment," in *Proc. SPIE Conf. Medical Imaging*, vol. 3337, San Diego, CA, Feb. 1998, pp. 73–84.
- [15] L. Zhang and **J. M. Reinhardt**, "Detection of lung lobar fissures using fuzzy logic," in *Proc. SPIE Conf. Medical Imaging*, vol. 3660, San Diego, CA, Feb. 1999, pp. 188–199.
- [16] **J. M. Reinhardt**, R. Uppaluri, W. E. Higgins, and E. A. Hoffman, "Pulmonary imaging," in *Medical Image Processing and Analysis*, J. M. Fitzpatrick and M. Sonka, Eds., SPIE Press, 2000.
- [17] O. I. Saba, E. A. Hoffman, and **J. M. Reinhardt**, "Computed tomographic-based estimation of airway size with correction for scanned plane tilt angle," in *Proc. SPIE Conf. Medical Imaging*, vol. 3978, San Diego, CA, Feb. 2000, pp. 58–66.
- [18] L. Zhang and **J. M. Reinhardt**, "3D pulmonary CT image registration with a standard lung atlas," in *Proc. SPIE Conf. Medical Imaging*, vol. 3978, San Diego, CA, Feb. 2000, pp. 67–77.

- [19] B. Li and **J. M. Reinhardt**, “Automatic generation of 3-D shape models and their application to tomographic image segmentation,” in *Proc. SPIE Conf. Medical Imaging*, vol. 4322, San Diego, CA, Feb. 2001, pp. 311–322.
- [20] F. Li, C.-W. Chen, E. A. Hoffman, and **J. M. Reinhardt**, “Evaluation and application of 3D lung warping and registration model using HRCT images,” in *Proc. SPIE Conf. Medical Imaging*, vol. 4321, San Diego, CA, Feb. 2001, pp. 234–243.
- [21] L. Zhang, E. A. Hoffman, and **J. M. Reinhardt**, “Lung lobar segmentation by graph search with 3D shape constraints,” in *Proc. SPIE Conf. Medical Imaging*, vol. 4321, San Diego, CA, Feb. 2001, pp. 204–215.
- [22] B. Li, G. E. Christensen, J. Dill, E. A. Hoffman, and **J. M. Reinhardt**, “3-D inter-subject warping and registration of pulmonary CT images for a human lung model,” in *Proc. SPIE Conf. Medical Imaging*, vol. 4683, San Diego, CA, Feb. 2002, pp. 324–335.
- [23] D. Gopalakrishnan, G. McLennan, M. Donnelley, A. Delsing, M. Suter, D. Flaherty, J. Zabner, E. A. Hoffman, and **J. M. Reinhardt**, “Color bronchoscopic analysis of the human airway tree,” in *Proc. SPIE Conf. Medical Imaging*, vol. 4683, San Diego, CA, Feb. 2002, pp. 341–351.
- [24] J. Guo, **J. M. Reinhardt**, H. Kitaoka, L. Zhang, G. McLennan, and E. A. Hoffman, “Integrated system for CT-based assessment of parenchymal lung disease,” in *2002 International Symposium on Biomedical Imaging*, Washington, DC, Jul. 2002, pp. 871–874.
- [25] A. Kiraly, W. E. Higgins, E. A. Hoffman, G. McLennan, and **J. M. Reinhardt**, “3D human airway segmentation for virtual bronchoscopy,” in *Proc. SPIE Conf. Medical Imaging*, vol. 4683, San Diego, CA, Feb. 2002, pp. 16–29.
- [26] L. Arbach, L. Bennett, **J. M. Reinhardt**, and G. Fallouh, “Breast mass classification: Comparison between human readers and a back-propagation neural network,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5032, San Diego, CA, 2003, pp. 810–818.
- [27] L. Arbach, L. Bennett, **J. M. Reinhardt**, and G. Fallouh, “Mammogram breast mass classification with backpropagation neural network,” in *IEEE Canadian Conference on Electrical and Computer Engineering*, vol. 3, Montreal, May 2003, pp. 1441–1444.
- [28] L. Zhang, E. A. Hoffman, and **J. M. Reinhardt**, “Atlas-driven lung lobe segmentation in volumetric X-ray CT images,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5032, San Diego, CA, 2003, pp. 309–319.
- [29] L. Arbach, A. Stolpen, and **J. M. Reinhardt**, “Classification of breast MRI lesions using a backpropagation neural network (BNN),” in *2004 International Symposium on Biomedical Imaging*, Washington, DC, 2004, pp. 253–256.
- [30] J. de Ryk, E. Namati, **J. M. Reinhardt**, C. Piker, Y. Xu, L. Liu, E. A. Hoffman, and G. McLennan, “A whole organ serial sectioning and imaging system for correlation of pathology to computer tomography,” in *Proc. SPIE Conf. Photonics West*, vol. 5324, San Jose, CA, 2004, pp. 224–234.

- [31] S. Krishnan, K. C. Beck, **J. M. Reinhardt**, K. A. Carlson, B. A. Simon, R. K. Albert, and E. A. Hoffman, “Regional lung ventilation from volumetric CT scans using image warping functions,” in *2004 International Symposium on Biomedical Imaging*, Washington, DC, 2004, pp. 792–795.
- [32] L. Shi, E. A. Hoffman, and **J. M. Reinhardt**, “Segmentation of the ovine lung in 3D CT images,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5369, San Diego, CA, 2004, pp. 455–463.
- [33] M. Suter, **J. M. Reinhardt**, M. Sonka, W. E. Higgins, E. A. Hoffman, and G. McLennan, “Three-dimensional true color topographical analysis of the pulmonary airways,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5369, San Diego, CA, 2004, pp. 189–198.
- [34] S. Ukil and **J. M. Reinhardt**, “Smoothing lung segmentation surfaces in 3D X-ray CT images using anatomic guidance,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5370, San Diego, CA, 2004, pp. 1066–1075.
- [35] A. Kiraly, **J. M. Reinhardt**, E. A. Hoffman, G. McLennan, and W. E. Higgins, “Virtual bronchoscopy for quantitative airway analysis,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5746, San Diego, CA, 2005, pp. 369–383.
- [36] Z. Markowitz, M. Loew, and **J. M. Reinhardt**, “The use and benefit of stereology in choosing a CT scanning protocol for the lung,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5747, San Diego, CA, 2005, pp. 667–674.
- [37] Y. Pan, D. Kumar, E. A. Hoffman, G. E. Christensen, G. McLennan, J. H. Song, A. Ross, B. A. Simon, and **J. M. Reinhardt**, “Regional lung expansion via 3D image registration,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5746, San Diego, CA, 2005, pp. 453–464.
- [38] M. Suter, **J. M. Reinhardt**, D. Easker, D. Riker, E. A. Hoffman, and G. McLennan, “Classification of pulmonary airway disease based on mucosal color analysis,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5746, San Diego, CA, 2005, pp. 465–473.
- [39] M. Suter, **J. M. Reinhardt**, E. A. Hoffman, and G. McLennan, “3D pulmonary airway color image reconstruction via shape from shading and virtual bronchoscopy imaging techniques,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5747, San Diego, CA, 2005, pp. 775–763.
- [40] J. Thiesse, **J. M. Reinhardt**, J. de Ryk, J. Leinen, W. Recheis, E. A. Hoffman, and G. McLennan, “Three-dimensional visual truth of the normal airway tree for use as a quantitative comparison to micro-CT reconstructions,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5746, San Diego, CA, 2005, pp. 369–383.
- [41] S. Ukil, E. A. Hoffman, and **J. M. Reinhardt**, “Automatic lung lobe segmentation in X-ray CT images by 3D watershed transform using anatomic information from the segmented airway tree,” in *Proc. SPIE Conf. Medical Imaging*, vol. 5747, San Diego, CA, 2005, pp. 556–567.
- [42] J. de Ryk, J. Thiesse, **J. M. Reinhardt**, E. A. Hoffman, and G. McLennan, “Establishing multi-modality datasets with the incorporation of 3D histopathology for soft tissue imaging,” in *Proc. SPIE Conf. Medical Imaging*, vol. 6144, San Diego, CA, 2006, pp. 1028–1035.

- [43] S. Ukil, M. Sonka, and **J. M. Reinhardt**, “Automatic segmentation of pulmonary fissures in X-ray CT images using anatomic guidance,” in *Proc. SPIE Conf. Medical Imaging*, vol. 6144, San Diego, CA, 2006, pp. 213–223.
- [44] M. Sonka, J. Tschirren, S. Ukil, X. Zhang, Y. Xu, **J. M. Reinhardt**, E. J. R. van Beek, G. McLennan, and E. A. Hoffman, “Pulmonary CT image analysis and computer aided detection,” in *Biomedical Imaging: From Nano to Macro, ISBI 2007. 4th IEEE International Symposium on Biomedical Imaging*, 2007, pp. 500–503.
- [45] J. de Ryk, J. Weydert, G. Christensen, J. Thiesse, E. Namati, **J. Reinhardt**, E. Hoffman, and G. McLennan, “Three dimensional histopathology of lung cancer with multimodality image registration,” in *Proc. SPIE Conf. Medical Imaging*, vol. 6512, San Diego, CA, 2007. DOI: 10.1117/12.710597.
- [46] S. Lee, M. Abramoff, and **J. M. Reinhardt**, “Feature-based pairwise retinal image registration by radial distortion correction,” in *Proc. SPIE Conf. Medical Imaging*, vol. 6512, San Diego, CA, 2007. DOI: 10.1117/12.710676.
- [47] L. Shi, J. Thiesse, G. McLennan, E. A. Hoffman, and **J. M. Reinhardt**, “Three-dimensional murine airway segmentation in micro-CT images,” in *Proc. SPIE Conf. Medical Imaging*, vol. 6511, San Diego, CA, 2007. DOI: 10.1117/12.711213.
- [48] S. Lee, **J. M. Reinhardt**, and M. D. Abramoff, “Validation of retinal image registration algorithms by a projective imaging distortion model,” in *Proc IEEE Eng Med Biol Soc*, vol. 1, 2007, pp. 6471–6474.
- [49] P. Kellen, D. Becker, **J. M. Reinhardt**, and D. van Daele, “Tracking the motion of the hyoid bone in videofluoroscopic swallowing studies,” in *Proc. SPIE Conf. Medical Imaging*, vol. 6914, San Diego, CA, 2008. DOI: 10.1117/12.771198.
- [50] S. Lee, M. D. Abramoff, and **J. M. Reinhardt**, “Retinal image mosaicing using the radial distortion correction model,” in *Proc. SPIE Conf. Medical Imaging*, vol. 6914, San Diego, CA, 2008. DOI: 10.1117/12.773161.
- [51] S. Miyawaki, G. Constantinescu, T. Nakato, and **J. M. Reinhardt**, “A numerical study of flow around freshwater mussels,” in *River flow 2008: International conference on fluvial hydraulics*, 2008.
- [52] K. Ding, K. Cao, G. E. Christensen, E. A. Hoffman, and **J. M. Reinhardt**, “Registration-based regional lung mechanical analysis: Retrospectively reconstructed dynamic imaging versus static breath-hold image acquisition,” in *Proc. SPIE Conf. Medical Imaging*, vol. 7262, Feb. 2009. DOI: 10.1117/12.813694.
- [53] K. Cao, K. Ding, G. E. Christensen, and **J. M. Reinhardt**, “Tissue volume and vesselness measure preserving nonrigid registration of lung CT images,” in *Proc. SPIE Conf. Medical Imaging*, B. M. Dawant and D. R. Haynor, Eds., vol. 7623, 2010, p. 762 309. DOI: 10.1117/12.844541.
- [54] G. E. Christensen, N. Burnette, W. Gao, M. Shaker, **J. M. Reinhardt**, J. E. Cook-Granroth, G. McLennan, and E. A. Hoffman, “Human airway tree structure query atlas,” in *Proc. SPIE Conf. Medical Imaging*, R. C. Molthen and J. B. Weaver, Eds., vol. 7626, 2010, p. 762 611. DOI: 10.1117/12.844596.

- [55] V. Joshi, **J. M. Reinhardt**, and M. D. Abramoff, “Automated measurement of retinal blood vessel tortuosity,” in *Proc. SPIE Conf. Medical Imaging*, N. Karssemeijer and R. M. Summers, Eds., vol. 7624, 2010, 76243A. DOI: 10.1117/12.844641.
- [56] S. Lee, M. D. Abramoff, and **J. M. Reinhardt**, “Retinal atlas statistics from color fundus images,” in *Proc. SPIE Conf. Medical Imaging*, B. M. Dawant and D. R. Haynor, Eds., vol. 7623, 2010, p. 762310. DOI: 10.1117/12.843714.
- [57] V. Joshi, M. K. Garvin, **J. M. Reinhardt**, and M. D. Abramoff, “Automated method for the identification and analysis of vascular tree structures in retinal vessel network,” in *Proc. SPIE Conf. Medical Imaging*, R. M. Summers and B. van Ginneken, Eds., vol. 7963, 2011, pp. 7963–17. DOI: 10.1117/12.878712.
- [58] X. Xu, M. K. Garvin, M. D. Abramoff, and **J. M. Reinhardt**, “Simultaneous automatic detection of the optic disc and fovea on fundus photographs,” in *Proc. SPIE Conf. Medical Imaging*, B. M. Dawant and D. R. Haynor, Eds., vol. 7962, Orlando, FL, Feb. 2011. DOI: 10.1117/12.877801.
- [59] K. Ding, K. Du, K. Cao, G. E. Christensen, and **J. M. Reinhardt**, “Time-varying lung ventilation analysis of 4DCT using image registration,” in *Proc. of 2011 IEEE International Conference on Acoustics, Speech and Signal Processing*, 2011, pp. 5772–5775. DOI: 10.1109/ICASSP.2011.5947672.
- [60] K. Ding, K. Cao, W. Miller, G. Christensen, **J. Reinhardt**, S. Benedict, B. Libby, and K. Sheng, “Correlation of measures of regional lung ventilation from 4DCT vs. hyperpolarized helium-3 MR,” in *Proc. SPIE Conf. Medical Imaging*, R. C. Molthen and J. B. Weaver, Eds., vol. 8317, San Diego, California, USA: SPIE, 2012, 83171E. DOI: 10.1117/12.912793.
- [61] X. Xu, M. D. Abramoff, G. Bertelsen, and **J. M. Reinhardt**, “Retinal vessel width measurement at branching points using an improved electric field theory-based graph approach,” in *Proc. SPIE Conf. Medical Imaging*, D. R. Haynor and S. Ourselin, Eds., vol. 8314, San Diego, California, USA: SPIE, 2012, 83144K. DOI: 10.1117/12.911831.
- [62] R. Amelon, K. Cao, **J. M. Reinhardt**, G. E. Christensen, and M. Raghavan, “Estimation of lung lobar sliding using image registration,” in *Proc. SPIE Conf. Medical Imaging*, R. C. Molthen and J. B. Weaver, Eds., vol. 8317, San Diego, CA: SPIE, 2012, 83171H. DOI: 10.1117/12.911614.
- [63] V. S. Joshi, M. K. Garvin, **J. M. Reinhardt**, and M. D. Abramoff, “Automated artery-venous classification of retinal blood vessels based on structural mapping method,” in *Proc. SPIE Conf. Medical Imaging*, B. van Ginneken and C. L. Novak, Eds., vol. 8315, San Diego, California, USA: SPIE, 2012, p. 83151C. DOI: 10.1117/12.911490.
- [64] R. L. Amendola, **J. M. Reinhardt**, Y. Sato, M. B. Zimmerman, H. R. Diggelmann, and D. Kacmarynski, “Graph-based segmentation of the pediatric trachea in MR images to model growth,” in *Proc. SPIE Conf. Medical Imaging*, J. B. Weaver and R. C. Molthen, Eds., vol. 8672, Lake Buena Vista, FL, 2013, p. 867210. DOI: 10.1117/12.2006290.
- [65] K. Du, **J. M. Reinhardt**, G. Christensen, K. Ding, B. Zhao, and J. Bayouth, “Evaluation of composed lung ventilation with 4DCT and image registration,” *Medical Physics*, vol. 41, no. 6, pp. 409–409, 2014, Abstract.



- [66] T. Patton, K. Du, G. Christensen, **J. M. Reinhardt**, and J. Bayouth, “Consistency of lung expansion and contraction during respiration: Implications for quantitative imaging,” *Medical Physics*, vol. 41, no. 6, pp. 449–450, 2014, Abstract.
- [67] T. Patton, K. Du, G. E. Christensen, **J. M. Reinhardt**, and J. E. Bayouth, “Consistency of 4DCT-based lung expansion and validation of radiation-induced ventilation changes,” in *AAPM North Central Chapter Autumn Meeting*, Abstract, 2014.
- [68] G. G. Zhang, K. Latifi, K. Du, **J. M. Reinhardt**, G. E. Christensen, K. Ding, V. Feygelman, and E. G. Moros, “Evaluation of the  $\Delta V$  ventilation calculation method using in vivo Xe CT ventilation data,” in *Proceedings of 2015 World Congress on Medical Physics and Biomedical Engineering*, 2015.
- [69] S. Bodduluri, S. Bhatt, M. Han, J. Newell, J. Sieren, M. Dransfield, E. Hoffman, and **J. M. Reinhardt**, “Discordance between CT measures of COPD and spirometry: Assessment of mechanistic differences,” *European Respiratory Journal*, vol. 44, no. Suppl 58, P645, 2014, Abstract.
- [70] K. Du, T. Patton, **J. M. Reinhardt**, G. E. Christensen, B. Zhao, S. E. Gerard, Y. Pan, and J. E. Bayouth, “Lobar-level lung ventilation analysis using 4DCT and deformable image registration,” *Medical Physics*, vol. 42, no. 6, pp. 3284–3285, 2015, Abstract.
- [71] T. Patton, K. Du, G. E. Christensen, **J. M. Reinhardt**, and J. E. Bayouth, “Predicting radiation therapy induced ventilation changes using 4DCT Jacobian calculations,” *Medical Physics*, vol. 42, no. 6, pp. 3630–3630, 2015, Abstract.
- [72] T. Patton, K. Du, G. E. Christensen, **J. M. Reinhardt**, and J. E. Bayouth, “Predicting ventilation change due to radiation therapy: Dependency on pre-RT ventilation and effort correction,” *Medical Physics*, vol. 43, no. 6, pp. 3459–3459, 2016, (abstract).
- [73] T. Patton, K. Du, G. E. Christensen, **J. M. Reinhardt**, and J. E. Bayouth, “Quantifying ventilation change due to radiation therapy using 4DCT Jacobian calculations,” *Medical Physics*, vol. 43, no. 6, pp. 3794–3795, 2016, (abstract).
- [74] K. Du, T. Patton, **J. M. Reinhardt**, G. E. Christensen, and J. E. Bayouth, “Correlating lung CT HU with transformation-based and Xe-CT derived ventilation,” *Medical Physics*, vol. 43, no. 6, pp. 3795–3795, 2016, (abstract).
- [75] S. Bodduluri, S. G. Yeary, and **J. M. Reinhardt**, “Image registration-based lung mechanics for COPD phenotyping,” in *Proceedings of World Congress on Computational Biomechanics, WCCM XII*, (abstract), 2016.
- [76] J. Kipritidis, G. Cazoulat, B. Tahir, M. Hofman, S. Siva, J. Callahan, T. Yamamoto, G. E. Christensen, **J. M. Reinhardt**, N. Kadoya, T. J. Patton, S. E. Gerard, I. Duarte, B. Archibald-Heeren, M. Byrne, *et al.*, “The VAMPIRE challenge: Results of an international multi-institutional validation study to evaluate CT ventilation imaging algorithms,” *Medical Physics*, 2017, (abstract).
- [77] T. J. Patton, S. E. Gerard, G. E. Christensen, **J. M. Reinhardt**, and J. E. Bayouth, “Removing interpolation artifacts in respiratory-gated 4DCT for improved ventilation estimation,” *Medical Physics*, 2017, (abstract).

- [78] J. E. Bayouth, T. J. Patton, S. E. Gerard, G. E. Christensen, A. M. Baschnagel, and **J. M. Reinhardt**, “Clinical application of functional planning technique designed to improve lung toxicity,” *Medical Physics*, 2017, (abstract).
- [79] J. E. Bayouth, T. J. Patton, S. E. Gerard, G. E. Christensen, A. M. Baschnagel, and **J. M. Reinhardt**, “Reducing patient respiration induced 4DCT image artifacts,” *Medical Physics*, 2017, (abstract).
- [80] S. Bodduluri, **J. M. Reinhardt**, E. A. Hoffman, J. D. Newell, J. C. Sieren, M. Dransfield, and S. P. Bhatt, “Weighted density difference between paired computed tomography (CT) scans as a metric of lung function to predict FEV1 decline in chronic obstructive pulmonary disease (COPD),” in *A103. COPD: DISEASE PROGRESSION AND PROGNOSIS*, (abstract), American Thoracic Society, 2017, A2712–A2712.
- [81] S. Bodduluri, **J. M. Reinhardt**, E. A. Hoffman, J. D. Newell, H. P. Nath, J. C. Sieren, M. Dransfield, and S. P. Bhatt, “A simple global measure of functional small airway disease (fSAD) in chronic obstructive pulmonary disease (COPD): A “density-mask” based approach,” in *C22. COPD PHENOTYPES*, (abstract), American Thoracic Society, 2017, A4991–A4991.
- [82] W. Shao, S. E. Gerard, Y. Pan, T. J. Patton, **J. M. Reinhardt**, O. C. Durumeric, J. E. Bayouth, and G. E. Christensen, “Sensitivity analysis of Jacobian determinant used in treatment planning for lung cancer,” in *Proc. SPIE Conf. Medical Imaging*, SPIE, 2018.
- [83] S. Bodduluri, S. E. Gerard, **J. M. Reinhardt**, E. A. Hoffman, J. D. Newell, H. P. Nath, M. Dransfield, and S. P. Bhatt, “Silent zones of disease in active smokers,” in (abstract), American Thoracic Society, 2018.
- [84] S. E. Gerard, J. Herrmann, D. W. Kaczka, and **J. M. Reinhardt**, “Transfer learning for segmentation of injured lungs in computed tomography,” Biomedical Engineering Society Annual Meeting. Platform presentation., Atlanta, GA, 2018.
- [85] Y. Pan, G. E. Christensen, W. Shao, S. E. Gerard, O. C. Durumeric, G. D. Hugo, and **J. M. Reinhardt**, “Pulmonary blood vessel and lobe surface varifold (PVSF) registration,” in *2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI 2020)*, Workshop on Interaction of Geometry and Topology in Biomedical Imaging (In press), 2020.
- [86] Z. W. Althof, D. Kaczka, G. Musch, and **J. M. Reinhardt**, “PRM reveals prone vs. supine lung tissue expansion differences in an ovine model of ARDS,” in *2020 BMES Virtual Annual Meeting*, (abstract), 2020.

## VI. Book Chapters

- [1] **J. M. Reinhardt** and W. E. Higgins, “Cardiac imaging,” in *Handbook of Image and Video Processing*, A. C. Bovik, Ed., Academic Press, 2000.
- [2] **J. M. Reinhardt**, R. Uppaluri, W. E. Higgins, and E. A. Hoffman, “Pulmonary imaging,” in *Medical Image Processing and Analysis*, J. M. Fitzpatrick and M. Sonka, Eds., SPIE Press, 2000.

- [3] **J. M. Reinhardt** and W. E. Higgins, “Cardiac imaging,” in *Handbook of Image and Video Processing*, A. C. Bovik, Ed., Academic Press, 2005.
- [4] L. A. Meinel and **J. M. Reinhardt**, “Breast MRI computer-aided diagnosis systems,” in *Recent advances in breast imaging, mammography, and computer-aided diagnosis of breast cancer*, J. S. Suri and R. M. Rangayyan, Eds., SPIE Press, 2006, pp. 791–832.
- [5] K. Cao, K. Ding, R. E. Amelon, K. Du, **J. M. Reinhardt**, M. L. Raghavan, and G. E. Christensen, “Intensity-based registration for lung motion estimation,” in *4D Modeling and Estimation of Respiratory Motion for Radiation Therapy*, ser. Biological and Medical Physics, Biomedical Engineering, J. Ehrhardt and C. Lorenz, Eds., Springer, 2013, pp. 125–158. DOI: 10.1007/978-3-642-36441-9.
- [6] K. Ding, K. Cao, K. Du, R. Amelon, G. E. Christensen, M. Raghavan, and **J. M. Reinhardt**, “Estimation of lung ventilation,” in *4D Modeling and Estimation of Respiratory Motion for Radiation Therapy*, ser. Biological and Medical Physics, Biomedical Engineering, J. Ehrhardt and C. Lorenz, Eds., Springer, 2013, pp. 297–317. DOI: 10.1007/978-3-642-36441-9.