

Jens Petersen

Personal

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Research

My main research interest is in Medical Image Analysis. I have developed graph based methods for automatic segmentation of human airway walls in Computed Tomography images, which have also been applied to carotid artery segmentation in ultrasound and magnetic resonance images; algorithms for identifying specific segmental bronchi of the airway trees; methods for matching of bronchi in repeated scans of the same subject using image registration; and algorithms for statistical comparisons of trees and graphs. The developed methods allow fully automatic cross-sectional as well as longitudinal studies of airway abnormalities and have been used in one of the largest CT based analysis of airways conducted to date, consisting of the entire population of the Danish Lung Cancer Screening Trial (10,000 scans). I have (co-)authored 15 peer-reviewed papers and 6 peer-reviewed abstracts.

Education

Jan 2011 - May 2014 **Ph.D. in Medical Image Analysis**,
Department of Computer Science, University of Copenhagen
Thesis: Analysis of Airways in Computed Tomography
Supervised by Dr. Marleen de Bruijne
Co-supervised by Prof. Asger Dirksen

Sep 2010 **M.Sc. Computer Science**, University of Copenhagen
Thesis: Three-dimensional Graph Cuts for Human Airway Analysis
Supervised by Prof. Mads Nielsen
Nominated for best computer science thesis in Denmark 2010

Apr 2005 **B.Sc. Computer Science**, University of Copenhagen

Employment

May 2014 - Present **Postdoc**, Image Group, Department of Computer Science,
University of Copenhagen

Jan 2011 - May 2014 **Ph.D. student**, Image Group, Department of Computer Science,
University of Copenhagen

Sep 2010 - Dec 2010 **Research assistant**, Image Group, Department of Computer Science,
University of Copenhagen

Feb 2009 - Dec 2009 **Software developer** at Unotech A/S, Køge

Feb 2006 - Jan 2009 **Software developer** at Innovus A/S, Glostrup

Feb 2000 - Mar 2004 **Software developer (Co-op)** at Tellabs Denmark, Ballerup

Teaching and Supervision

- 2014 **Graduate level co-supervisor**, Porous chalk rocks segmentation (MSc thesis)
- 2013 **Undergraduate level supervisor**, Lobe segmentation project (BSc thesis)
- 2012 **Graduate level supervisor**, Lobe segmentation project (Advanced CMM and eScience)
- 2012 **Undergraduate level teaching assistant**,
Numerical Solution of Differential Equations: Finite Difference Methods
- 2011 **Graduate level teaching assistant and lecturer**, Medical Image Analysis
- 2011 **Graduate level teaching assistant**,
Numerical solution of differential equations: Finite Difference methods

Research Stays

- Jan 2013 - May 2013 **University College London (England)**,
Visited Prof. Sebastien Ourselin and collaborators at the Centre for
Medical Image Computing to work on longitudinal airway analysis.

Invited Talks

- 2014 Airway Segmentation using Optimal Surfaces, Visionday 2014, DTU Compute, Technical University of Denmark, Lyngby, Denmark
- 2013 Quantitative Analysis of Airway Abnormalities in CT images, Biomedical Imaging Group Rotterdam, Departments of Medical Informatics, Erasmus University Medical Center Rotterdam, the Netherlands
- 2013 Quantification of Chronic Obstructive Pulmonary Disease Related Airway Abnormalities from CT, Centre for Medical Image Computing, University College London, England
- 2012 DLCST, KOL og luftveje, Department of Respiratory Medicine, Gentofte Hospital, Denmark
- 2012 Optimal Surface Segmentation by Graph Cuts (Applied to Airway Segmentation in Lung CT), Biomedical Imaging Group Rotterdam, Departments of Medical Informatics Erasmus University Medical Center Rotterdam, the Netherlands
- 2011 Optimal Net Surface Segmentation, Application to Airway Walls in CT Images, Summer School on Graphs in Computer Graphics, Image and Signal Analysis, Rutsker, Denmark
- 2010 Quantitative Analysis of Airway Abnormalities Associated with COPD, International Conference on CT Screening for Lung Cancer, Copenhagen, Denmark

Presentations at International Conferences

- 2013 Quantitative Airway Analysis in Longitudinal Studies using Groupwise Registration and 4D Optimal Surfaces (Poster), Medical Image Computing and Computer Assisted Intervention 2013, Nagoya, Japan
- 2013 The Effect of Inspiration on Airway Dimensions Measured in CT Images from the Danish Lung Cancer Screening Trial (Oral), European Congress of Radiology, Vienna, Austria
- 2013 An Automatic System for Segmentation, Matching, Anatomical Labeling and Measurement of Airways from CT Images (Oral), ECR 2013 Novel Technology that Shapes Radiology: EIBIR presents IMAGINE, Vienna, Austria
- 2012 A Hierarchical Scheme for Geodesic Anatomical Labeling of Airway Trees (Poster), Medical Image Computing and Computer Assisted Intervention 2012, Nice, France
- 2011 Longitudinal Analysis of Airways using Registration (Oral), Fourth International Workshop on Pulmonary Image Analysis, Toronto, Canada
- 2011 Optimal Graph Based Segmentation Using Flow Lines with Application to Airway Wall Segmentation (Oral), Information Processing in Medical Imaging, Kloster Irsee, Germany

Papers in international journals (peer reviewed)

- 2014 *Feragen, A, ***Petersen, J.**, Owen, M., Lo, P., Wille, L. T. M. M. W., Dirksen, A., and de Bruijne, M. (2014). Geodesic atlas-based labeling of anatomical trees: Application and evaluation on airways extracted from CT. *IEEE Trans Med Imag*, (In press)
- Petersen, J.**, Wille, M. M. W., Rakêt, L. L., Feragen, A., Pedersen, J. H., Nielsen, M., Dirksen, A., and de Bruijne, M. (2014b). Effect of inspiration on airway dimensions measured in maximal inspiration CT images of subjects without airflow limitation. *European Radiology*, 24(9):2319–2325
- Wille, M. M. W., Thomsen, L. H., Dirksen, A., **Petersen, J.**, Pedersen, J. H., and Shaker, S. B. (2014). Emphysema progression is visually detectable in low-dose CT in continuous but not in former smokers. *European Radiology*, 24(11):2692–2699
- Petersen, J.**, Nielsen, M., Lo, P., Nordenmark, L. H., Pedersen, J. H., Wille, M. M. W., Dirksen, A., and de Bruijne, M. (2014a). Optimal surface segmentation using flow lines to quantify airway abnormalities in chronic obstructive pulmonary disease. *Med Image Anal*, 18(3):531–541

Papers in conference proceedings (peer reviewed)

- 2013 Feragen, A., Kasenburg, N., **Petersen, J.**, de Bruijne, M., and Borgwardt, K. (2013a). Scalable kernels for graphs with continuous attributes. In *Neural Information Processing Systems (NIPS 2013)*, volume 26, pages 216–224
- Petersen, J.**, Modat, M., Cardoso, M. J., Dirksen, A., Ourselin, S., and de Bruijne, M. (2013c). Quantitative airway analysis in longitudinal studies using groupwise registration and 4D optimal surfaces. In Mori, K., Sakuma, I., Sato, Y., Barillot, C., and Navab, N., editors, *Med Image Comput Assist Interv - MICCAI 2013*, Lecture Notes in Computer Science, pages 287–294. Springer
- Arias, A., Carvalho, D., **Petersen, J.**, van Dijk, A., van der Lugt, A., Niessen, W., Klein, S., and de Bruijne, M. (2013). Carotid artery lumen segmentation on 3D free-hand ultrasound images using surface graph cuts. In Mori, K., Sakuma, I., Sato, Y., Barillot, C., and Navab, N., editors, *Med Image Comput Assist Interv - MICCAI 2013*, Lecture Notes in Computer Science, pages 542–549. Springer
- Feragen, A., Owen, M., **Petersen, J.**, Wille, M. M. W., Thomsen, L. H., Dirksen, A., and de Bruijne, M. (2013b). Tree-space statistics and approximations for large-scale analysis of anatomical trees. In Wells, W., Joshi, S., and Pohl, K., editors, *Information Processing in Medical Imaging*, Lecture Notes in Computer Science, pages 74–85. Springer
- Feragen, A., **Petersen, J.**, Grimm, D., Dirksen, A., Pedersen, J. H., Borgwardt, K., and de Bruijne, M. (2013c). Geometric tree kernels: Classification of COPD from airway tree geometry. In Wells, W., Joshi, S., and Pohl, K., editors, *Information Processing in Medical Imaging*, Lecture Notes in Computer Science, pages 171–183. Springer
- 2012 Feragen, A., **Petersen, J.**, Owen, M., Lo, P., Thomsen, L. H., Wille, M. M. W., Dirksen, A., and de Bruijne, M. (2012). A hierarchical scheme for geodesic anatomical labeling of airway trees. In *Med Image Comput Assist Interv - MICCAI 2012*, Lecture Notes in Computer Science, pages 147–155. Springer

- Arias, A., **Petersen, J.**, van Engelen, A., Tang, H., Selwaness, M., Witteman, J., van der Lugt, A., Niessen, W., and de Bruijne, M. (2012). Carotid artery wall segmentation by coupled surface graph cuts. In Menze, B., Langs, G., Lu, L., Montillo, A., Tu, Z., and Criminisi, A., editors, *Medical Computer Vision. Recognition Techniques and Applications in Medical Imaging*, pages 38–47
- 2011 **Petersen, J.**, Gorbunova, V., Nielsen, M., Dirksen, A., Lo, P., and de Bruijne, M. (2011a). Longitudinal analysis of airways using registration. In Beichel, R., de Bruijne, M., van Ginneken, B., Kabus, S., Kiraly, A., Kuhnigk, J., McClelland, J., Mori, K., van Rikxoort, E., and Rit, S., editors, *Fourth International Workshop on Pulmonary Image Analysis*, pages 11–22. CreateSpace
- Sørensen, L., Lo, P., **Petersen, J.**, Dirksen, A., and de Bruijne, M. (2011). Dissimilarity-based classification of anatomical tree structures. In Székely, G. and Hahn, H., editors, *Information Processing in Medical Imaging*, Lecture Notes in Computer Science, pages 475–485. Springer
- Petersen, J.**, Nielsen, M., Lo, P., Saghir, Z., Dirksen, A., and de Bruijne, M. (2011b). Optimal graph based segmentation using flow lines with application to airway wall segmentation. In Székely, G. and Hahn, H. K., editors, *Information Processing in Medical Imaging*, Lecture Notes in Computer Science, pages 49–60. Springer
- 2010 **Petersen, J.**, Lo, P., Nielsen, M., Eudala, G., Ashraf, H., Dirksen, A., and de Bruijne, M. (2010). Quantitative analysis of airway abnormalities in CT. In Karssemeijer, N. and Summers, R., editors, *Medical Imaging: Computer-Aided Diagnosis*, Proceedings of SPIE 7624, pages 76241S–76241S–12. SPIE Press

Abstracts in conference proceedings (peer reviewed)

- 2015 Perez-Rovira, A., Kuo, W., **Petersen, J.**, Tiddens, H. A. W. M., and de Bruijne, M. (2015 (accepted)). Automated quantification of bronchiectasis, airway wall thickening and lumen tapering in chest CT. In *ECR - Annual meeting of the European Society of Radiology*
- 2013 Wille, M. M., **Petersen, J.**, Dirksen, A., and de Bruijne, M. (2013). Airway distensibility in chronic obstructive pulmonary disease - evaluation by CT airway segmentation and lung density measurement based on the danish lung cancer screening trial. In *American Thoracic Society International Conference (ATS)*
- Petersen, J.**, Feragen, A., Owen, M., Wille, M. M., Thomsen, L. H., Dirksen, A., and de Bruijne, M. (2013a). Automatic system for segmentation, longitudinal matching, anatomical labeling and measurements of airways from CT images. In *Novel technology that shapes Radiology: EIBIR presents IMAGINE*
- Petersen, J.**, Feragen, A., Thomsen, L. H., Wille, M. M., Dirksen, A., and de Bruijne, M. (2013b). Manual airway labeling has limited reproducibility. In *ECR - Annual meeting of the European Society of Radiology*
- Petersen, J.**, Wille, M. M., Thomsen, L. H., Feragen, A., Dirksen, A., and de Bruijne, M. (2013d). The effect of inspiration on airway dimensions measured in CT images from the danish lung cancer screening trial. In *ECR - Annual meeting of the European Society of Radiology*

- 2012 Wille, M. M., Thomsen, L. H., **Petersen, J.**, Shaker, S. B., Dirksen, A., and Pedersen, J. H. (2012). Interobserver variability in visual evaluation of thoracic CT scans and comparison with automatic computer measurements of CT lung density. In *European Respiratory Society, Annual Congress, Vienna*

Theses

- 2014 **Petersen, J.** (2014). *Analysis of Airways in Computed Tomography*. Phd, Department of Computer Science, University of Copenhagen, Denmark
- 2010 **Petersen, J.** (2010). *Three-dimensional graph cuts for human airway analysis*. Master's thesis, Department of Computer Science, University of Copenhagen, Denmark