

Fusion of X-ray angiography and optical coherence tomography for coronary flow simulation Li, Y.

Citation

Li, Y. (2018, October 9). Fusion of X-ray angiography and optical coherence tomography for coronary flow simulation. ASCI dissertation series. Retrieved from https://hdl.handle.net/1887/66128

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Issue Date: 2018-10-09

Acknowledgements

The work described in this thesis was performed under the supervision of Prof. dr. j.H.C Reiber and Prof. dr. Shengxian Tu at the Division of Imaging Processing (LKEB), Department of Radiology, Leiden University Medical Center and at the Department of Applied Research, Medis medical imaging system by, the Netherlands.

First, I would like to thank Hans, who gives me great support, trust and encouragement. Dear Hans, without your support, I cannot go this far in the academic world. I would like to thank Shengxian (Sanven), who performs as my daily supervisor. Dear Sanven, you guide me in my research road and inspire me with your huge academic passion. I also want to thank Boudewijn, who helps me a lot in my PHD progress and the thesis revision.

I would like to thank all my co-authors for your contributions in my research. Niels Holm, thank you for your precious data and suggestions. Juan Gutiérrez-Chico, thank you for your great ideas and efforts. I learn a lot from you. It was your insistence that made the miracle happened. Karanasos Antonios, thank you for sharing your ideas and supporting the data. Dear Jouke, thank you for your enthusiastic help and quick technical support. Chu Miao, Zehang Li and Yunxiao Chang, I really appreciate your efforts. Thank you all.

I am grateful to all my colleagues in Medis and in LKEB. Jasper, I learn a lot technical skills from you. It is nice to have you as my friend. I would like also to thank Pieter, who helps me so much on Mevislab. It is happy to talk and to share living thoughts and experiences with Joan, Gerhard, Rolf, Sylvia and Kevin. I also want to thank Guido, Marco and Marcel, who enthusiastically helped me with my Dutch translation. Xinpei, I enjoy talking with you and sharing ideas with you. Daniel, Bob, David and all the other Medis colleagues, I have too many wonderful memories with you, when we went bowling, Segway, karting, barbecue and etc. Shengnan Liu, Qing Cao, Zhiwei Zhai, Qian Tao, Ling Llin, Lu Huang, Chenhong, Yuchuan, Zhuo, Hessam and Floris, it is very happy to meet you in LKEB and to travel together in our spare time.

Besides, I feel lucky to have many friends in Leiden. Yifei Bi, Jia Liu, Rui Zhang, Wenbo, Guangsheng, Puning, Hui Chen, Cui Chen, Ai Zhang, Jing Niu, Jing Zhang, Li Kong, Ka Zhang, Quanchi, Feng Jiang, Lin Jiang, Wei Li, Mengmeng Sun, Min He, Yangan Chen and many others, we helped and encouraged each other. The moments when we stayed together will last long in my memory. It is also quite pleasant to meet Chaoping Zhang, Tian Zhang, Yuanyuan Sun, Wei Sun, Hua Ma and Yao Yao through courses and conferences. I obtained so many academic ideas and technical methods from our discussions.

Finally, I would love to thank my parents and my sister. Thank you for your great care and unconditional support. Every time when I think of you, I would gain new strength to overcome difficulties.

Curriculum Vitae

Yingguang Li was born in Handan, Hebei, China in 1988. In 2007, He graduated from Hengshui High School and started his bachelor study at South China University of Technology, Guangdong, China. He finished the four-year bachelor courses in three years. In 2010, he received the bachelor degree of information engineering and he began his master study of signal and information processing at South China University of Technology in the same year. He obtained his master degree in 2013. After his graduation, he joined Medis medical imaging systems in Leiden as a scientific researcher, while pursuing a PhD degree at the Division of Image Processing (LKEB), Department of Radiology, Leiden University Medical Center, Leiden, the Netherlands, under the supervision of Prof. dr. ir. J.H.C. Reiber and Prof. dr. Shengxian Tu. He has been working on the project of coronary artery reconstruction by fusion of X-ray angiography and Optical Coherence Tomography (OCT) and the computational flow dynamics (CFD) analysis based on the reconstructed model. His work is presented in this thesis.

He was awarded the "Outstanding Oversea Chinese Student" for his PhD research by the Ministry of Education of the People's Republic of China in 2017.

Publications

Journal papers

- 1.**Yingguang Li**, Juan Luis Gutiérrez-Chico, Niels R. Holm, Wenjie Yang, Lasse Hebsgaard, Evald H. Christiansen, Michael Mæng, Jens F. Lassen, Fuhua Yan, Johan H.C. Reiber, Shengxian Tu. "Impact of side branch modeling on computation of endothelial shear stress in coronary artery disease: coronary tree reconstruction by fusion of 3D angiography and OCT." Journal of the American College of Cardiology 66, no. 2 (2015): 125-135.
- 2.Karanasos Antonios, **Yingguang Li**, Shengxian Tu, Jolanda J. Wentzel, Johan HC Reiber, Robert-Jan van Geuns, and Evelyn Regar. "Is it safe to implant bioresorbable scaffolds in ostial side-branch lesions? Impact of 'neo-carina'formation on main-branch flow pattern. Longitudinal clinical observations." Atherosclerosis 238, no. 1 (2015): 22-25.
- 3. Yingguang Li, Zehang Li, Emil Holck, Bo Xu, Antonios Karanasos, Zhenyu Fei, Yunxiao Chang, Miao Chu, Jouke Dijkstra, Evald Christiansen, Johan Reiber, Niels Holm, Shengxian Tu. "Local Flow Patterns after Implantation of Bioresorbable Vascular Scaffold in by Coronary Bifurcations: Novel Findings Computational Fluid Dynamics" Circulation Journal. 2018, CJ-17-1332. [DOI: https://doi.org/10.1253/circj.CJ-17-1332]
- 4. Yingguang Li, Niels R. Holm, Zhenyu Fei, Jouke Dijkstra, Emil N. Holck, Evald Høj Christiansen, Johan H. C. Reiber, Shengxian Tu. "In vivo reconstruction of coronary artery and bioresorbable stents from intracoronary optical coherence tomography", Proc. SPIE 10576, Medical **Imaging** 2018: Image-Guided Procedures, Robotic Interventions, and Modeling, 1057622 (13 March 2018); doi: 10.1117/12.2293711; https://doi.org/10.1117/12.2293711
- 5. Shengxian Tu, Emanuele Barbato, Zsolt Köszegi, Junqing Yang, Zhonghua Sun, Niels R. Holm, Balázs Tar, **Yingguang Li**, Dan Rusinaru, William Wijns, Johan H.C. Reiber. "Fractional flow reserve calculation from 3-dimensional quantitative coronary angiography and TIMI frame count: a fast computer model to quantify the functional significance of moderately obstructed coronary arteries." JACC: Cardiovascular Interventions 7, no. 7 (2014): 768-777.
- 6. Lili Liu, Wenjie Yang, Yasuomi Nagahara, **Yingguang Li**, Saeb R. Lamooki, Takashi Muramatsu, Pieter Kitslaar, Masayoshi Sarai, Yukio Ozaki, Peter Barlis, Fuhua Yan, Johan H. C. Reiber, Shengxian Tu. "The impact of image resolution on computation of fractional flow reserve: coronary computed tomography angiography versus 3-dimensional quantitative coronary angiography." The international journal of cardiovascular imaging 32, no. 3 (2016): 513-523.
 - 7. Konstantinos Toutouzas, Yiannis S. Chatzizisis, Maria Riga,

- Andreas Giannopoulos, Antonios P. Antoniadis, Shengxian Tu, Yusuke Fujino, Dimitrios Mitsouras, Charalampos Doulaverakis, Ioannis Tsampoulatidis, Vassilis G. Koutkias, Konstantina Bouki, **Yingguang Li**, Ioanna Chouvarda, Grigorios Cheimariotis, Nicos Maglaveras, Ioannis Kompatsiaris, Sunao Nakamura, Johan H.C. Reiber, Frank Rybicki, Haralambos Karvounis, Christodoulos Stefanadis, Dimitris Tousoulis, George D. Giannoglou. "Accurate and reproducible reconstruction of coronary arteries and endothelial shear stress calculation using 3D OCT: comparative study to 3D IVUS and 3D QCA." Atherosclerosis 240, no. 2 (2015): 510-519.
- 8.Shengxian Tu, Mauro Echavarria-Pinto, Clemens von Birgelen, Niels R. Holm, Stylianos A. Pyxaras, Indulis Kumsars, Ming Kai Lam, Ilona Valkenburg, Gabor G. Toth, **Yingguang Li**, Javier Escaned, William Wijns, Johan H.C. Reiber. "Fractional flow reserve and coronary bifurcation anatomy: a novel quantitative model to assess and report the stenosis severity of bifurcation lesions." JACC: cardiovascular interventions 8, no. 4 (2015): 564-574.
- 9.Shengxian Tu, Stylianos A. Pyxaras, **Yingguang Li**, Emanuele Barbato, Johan HC Reiber, and William Wijns. "In vivo flow simulation at coronary bifurcation reconstructed by fusion of 3-dimensional X-ray angiography and optical coherence tomography." Circulation: Cardiovascular Interventions 6, no. 2 (2013): e15-e17.
- 10.Dexiao Huang, Takashi Muramatsu, **Yingguang Li**, Wenjie Yang, Yasuomi Nagahara, Miao Chu, Pieter Kitslaar, Masayoshi Sarai, Yukio Ozaki, Yiannis S. Chatzizisis, Fuhua Yan, Johan H. C. Reiber, Renhua Wu, Jun Pu, Shengxian Tu. "Assessment of endothelial shear stress in patients with mild or intermediate coronary stenoses using coronary computed tomography angiography: comparison with invasive coronary angiography." The International Journal of Cardiovascular Imaging (2016): 1-10.
- 11.Li, S., Cheng Chin, Vikas Thondapu, Eric KW Poon, Jason P. Monty, **Yingguang Li**, Andrew SH Ooi, Shengxian Tu, and Peter Barlis. "Numerical and experimental investigations of the flow–pressure relation in multiple sequential stenoses coronary artery." The International Journal of Cardiovascular Imaging (2017): 1-6.
- Xinlei, Clemens von Birgelen, Takashi Yingguang Li, Niels Ramsing Holm, J. H. Reiber, and Shengxian Tu. "A novel four-dimensional angiographic approach to assess dynamic superficial wall stress of coronary arteries in vivo: Initial experience in vessel sites with subsequent plaque evaluating EuroIntervention: journal of EuroPCR in collaboration with the Working Group on Interventional Cardiology of the European Society of Cardiology (2017).
- 13.Wu, Xinlei, Clemens von Birgelen, Zehang Li, Su Zhang, Jiayue Huang, Fuyou Liang, **Yingguang Li**, William Wijns, and Shengxian Tu. "Assessment of superficial coronary vessel wall deformation and stress: validation of in silico models and human coronary arteries in vivo." The International Journal of Cardiovascular Imaging (2018): 1-13.

14.Chen, Hui, **Yingguang Li**, Johan HC Reiber, Jan de Lange, Shengxian Tu, Paul van der Stelt, Frank Lobbezoo, and Ghizlane Aarab. "Analyses of aerodynamic characteristics of the oropharynx applying CBCT: obstructive sleep apnea patients versus control subjects." Dentomaxillofacial Radiology 47, (2018): 20170238.

Abstracts

- 1.**Yingguang Li**, Juan Luis Gutiérrez-Chico, Niels R. Holm, Wenjie Yang, Lasse Hebsgaard, Evald H. Christiansen, Michael Maeng, Jens Flensted F. Lassen, Fuhua Yan, Johan H. Reiber and Shengxian Tu. "TCT-340 Impact of Side Branches Modeling on Computation of Endothelial Shear Stress in Coronary Artery Disease: a Novel Method for Patient-Specific Coronary Tree Reconstruction by Fusion of X-ray Angiography and Optical Coherence Tomography." Journal of the American College of Cardiology 66, no. 15_S (2015).
- 2.Lamooki, Saeb R., Takashi Muramatsu, Wenjie Yang, **Yingguang Li**, Yasuomi Nagahara, Pieter Kitslaar, Lili Liu, Masayoshi Sarai, Yukio Ozaki, Fuhua Yan, Johan H. Reiber and Shengxian Tu. "TCT-328 In Vivo Calculation of Endothelial Shear Stress Using Coronary Computed Tomography Angiography: Comparison with Invasive Coronary Angiography." Journal of the American College of Cardiology 66, no. 15_S (2015).
- 3.Shengxian Tu, Mauro Echavarria-Pinto, Clemens von Birgelen, Niels R. Holm, Stylianos A. Pyxaras, Indulis Kumsars, Ming Kai Lam, Ilona Valkenburg, Gabor G. Toth, **Yingguang Li**, Javier Escaned, William C. Wijns and Johan H. Reiber. "TCT-332 Relation Between Fractional Flow Reserve And Coronary Bifurcation Anatomy: A Novel Quantitative Model To Assess The Stenotic Severity Of Bifurcation Lesions." Journal of the American College of Cardiology 64, no. 11_S (2014).
- 4.**Yingguang Li**, Niels Holm, Zhenyu Fei, Jouke Dijkstra, Pieter Kitslaar, Emil Holck, Evald Christiansen, Johan Reiber, and Shengxian Tu. "TCT-567 In Vivo Reconstruction of Bioresorbable Stents and Its Impact on Computation of Shear Stress" Journal of the American College of Cardiology 68, no. 18 SUPPL B (2016): B229.