Xianjing Liu

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Research Areas: medical signal/image analysis; machine learning;

Educational Background

Department of Radiology & Nuclear Medicine, Erasmus MC 2019 – Present

PhD candidate in machine/deep learning

- Supervisor: Wiro Niessen; Eppo Wolvius; Gennady Roshchupkin

School of Medicine, Shenzhen University 2010 – 2017

Bachelor & Master of Engineering in signal and image processing

Research Experience

Erasmus Medical Center @Rotterdam, Netherlands. ML Researcher 2019-Present

Hong Kong Polytechnic University @Hong Kong, China. ML Research 2018–2019

Esqual Group @Guangdong, China. Vision System Engineer 2018–2019

Shenzhen Wisonic Co., Ltd. @Shenzhen, China. Imaging System Engineer 2017-2018

Papers

1. **X Liu**, B Li, et al. Projection-Wise Disentangling for Fair and Interpretable Representation Learning: Application to 3D Facial Shape Analysis. MICCAI. 2021

2. **X Liu**, M Kayser, et al. Association between prenatal alcohol exposure and children's facial shape. A prospective population-based cohort study. Human Reproduction. 2023 (Reposted by over 400 news outlets; advertising value equivalent (AVE) €38.4 million)

3. AW van Meijeren-van Lunteren, **X Liu**, et al. Oral and craniofacial research in the Generation R Study: An executive summary. Clinical Oral Investigations 2023

4. D Mo, WK Wong, **X Liu**, Y Ge. Concentrated hashing with neighborhood embedding for image retrieval and classification. IJMLC. 2022

5. J Huang, SC Chan, MS Tin, **X Liu**, et al. Worldwide Distribution, Risk Factors, and Temporal Trends of Testicular Cancer Incidence and Mortality: A Global Analysis. European Urology Oncology. 2022

6. J Huang, HK Patel, ... **X Liu**, et al. Worldwide distribution, associated factors, and trends of gallbladder cancer: A global country-level analysis. Cancer Letters. 2021

7. **X Liu**, B.Li, W. Niessen, E.B. Wolvius, A. Ikram, E.E. Bron, G.V. Roshchupkin, AI-based association analysis for medical imaging using latent-space geometric confounder correction, internal reviewing with co-authors

8. **X Liu**, T. Sangers, M. Kayser, LM. Pardo, T. Nijsten, E.B. Wolvius, G.V. Roshchupkin, M. Wakkee, Artificial Intelligence (AI) based skin cancer prediction using 2D facial images: a proof-of-concept study. Internal reviewing with co-authors

9. **X Liu**, Z. Xiong, E.B. Wovius, M. Kayser, F. Liu, G.V. Roshupkin. Integration of AI-based Phenotyping and combined GWAS reveal novel Genetic Insights of image-based complex traits with human face as example. Internal reviewing with co-authors

10. T.M. Choi, **X Liu**, T. Abdel-Alim, M.L.C. van Veelen, I.M.J. Mathijssen, E.B. Wolvius, G. V. Roshchupkin. Three-dimensional automatic analysis of facial asymmetry in patients with syndromic coronal synostosis. Submitted

♡ Awards

Grand Awards, AI-based Textile Material Inspection System, the 47th International Exhibition of Inventions Geneva 2019

Teaching/supervising experience

- Supervision of 5 master students from Technical University of Delft for 9-month thesis or 10-week internship
- Teaching assistant in the Advanced Image Processing course in Technical University of Delft.
- Teaching assistant in the Introduction of Deep Learning course in Erasmus Medical Center

Conferences and presentations

- Poster presentation in conference Medical Image Computing and Computer Assisted Intervention (MICCAI) 2021, France
- Oral presentation in conference European Society of Craniofacial Surgery (ESCFS) 2022, UK

Product development experience in industry

- AI-based Textile Material Anomaly Detection System —— I contributed to the AI algorithm and software development of this product.
- Ultrasound imaging system —— I contributed to the development of image reconstruction algorithm of this product.

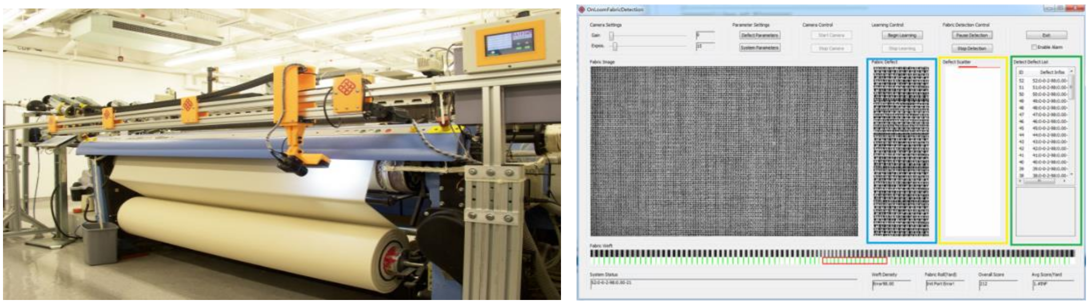
Selected projects:

1. WiseEye: AI-based Textile Material Inspection System (2018-2019 in industry)

A system including hardware component and software component is developed for on-loom fabric defect (i.e., anomaly) detection. Images captured by a camera are transmitted into a PC and then processed by algorithms which are integrated in the software. A GUI is also designed for user control purpose. The real-time inspection product was finally used in Esquel Group for commercial purpose. **I was the leader of this project, mainly contributed to selection of lens, cameras, lighting, AI algorithm and software development in this project.**

This innovation wins four prizes at the 47th International Exhibition of Inventions Geneva.

This project was funded by Hong Kong Polytechnic University, Hong Kong, China, in collaboration with Esquel Group, China.



(a) (b)

Figure 1: a) The AI-based textile material inspection system. A camera is sliding along the track, with image captured and sent to PC for AI-based inspection analysis; b) The software system showing the status.

2. Phase Correction for Multi-beam Imaging on Ultrasound Diagnosis System (2017-2018 in industry)

Multi-beam imaging is an innovative technique which can dramatically improve both the efficiency and quality of ultrasonic imaging. But the phase aberration caused by the curved wavefront compromises the image quality. To address this, I calculate the full sound field and derive the phase shift, which can be used for phase compensation. After correction, there is great improvement on ultrasound diagnosis system, especially in the near field imaging.

This project was funded by Shenzhen Wisonic Co., Ltd. China.

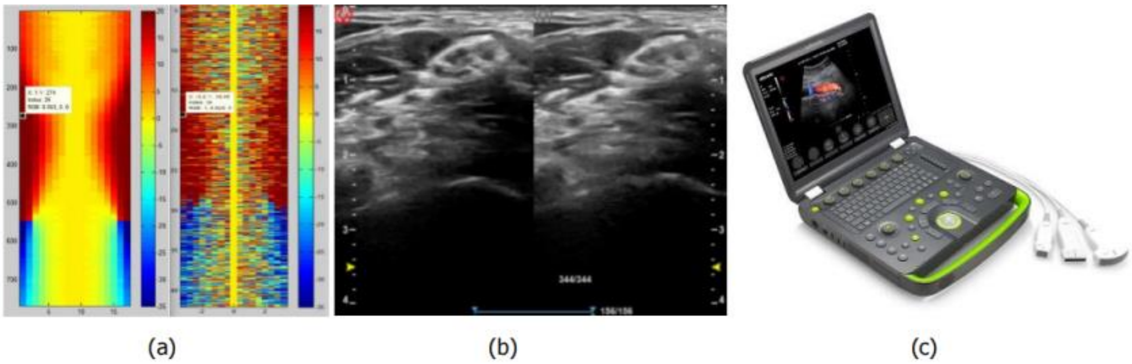


Figure 2: My efforts improved the imaging quality of the ultrasound system. a) The phase shift. Left: computed result; Right: measured value (with noise); b) The final imaging result. Left: after correction; Right: without correction; c) One of the systems which were integrated with my developed algorithm.

3. AI-based confounder-free association analysis in medical imaging (2020-2021 in academia)

The motivation of this work is to develop a state-of-the-art machine learning algorithm to address the interpretability and confounding issues in deep learning training. It was published in a top conference of medical image computing (MICCAI 2021), with a clinical application of examining the association between prenatal alcohol exposure and children's facial shape (Figure 3). Now I am working on extending it into a journal paper, with an additional experiment on investigating the association between the 3D brain image and cognitive function scores (Figure 4).

This project was funded by Erasmus Medical Center, Netherlands.

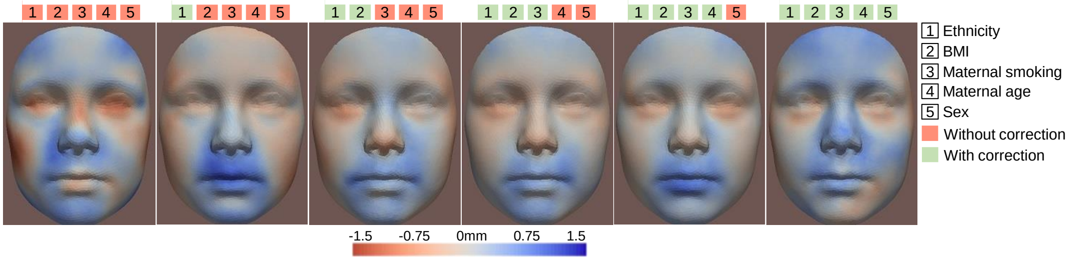


Figure 3: Facial heatmaps visualize how the facial shape changes from non-exposed to exposed to prenatal alcohol. Five confounders were included in the analysis: ethnicity, BMI, sex, maternal age and maternal smoking. Red areas refer to inward changes while blue areas refer to outward changes of the face with respect to the geometric center of the head.

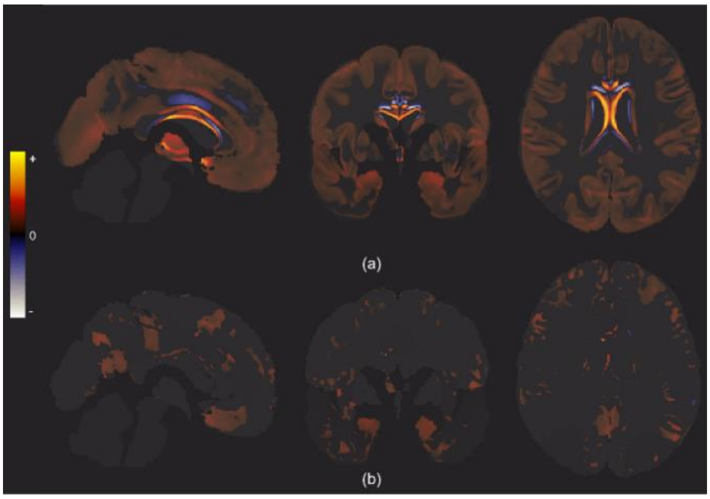


Figure 4: Supratentorial modulated grey matter maps visualize the relationship between g-factor (i.e., cognitive score) and brain image. (a) without correcting for confounders, and (b) with correcting for age, sex, and education years.

4. AI-based skin cancer risk prediction using 2D facial images: a proof-of-concept study (2021-2022 in academia)

AI methods achieved high accuracy on detecting skin cancer lesions, but its value in predicting the risk of developing skin cancer before the occurrence of lesions is unknown. A survival analysis was done to predict the risk of developing skin cancer by using 2D facial images (which were further encoded as facial endophenotypes using autoencoder) taken before participants were diagnosed with skin cancer, and compare with another analysis using known risk factors (e.g., age, sex) as predictors. Results show that the risk of developing skin is predictable from 2D facial images. Facial endophenotypes (c-index 0.73) outperform known risk factors (c-index 0.60) in predicting the risk of developing skin cancer.

This project was funded by Erasmus Medical Center, Netherlands.

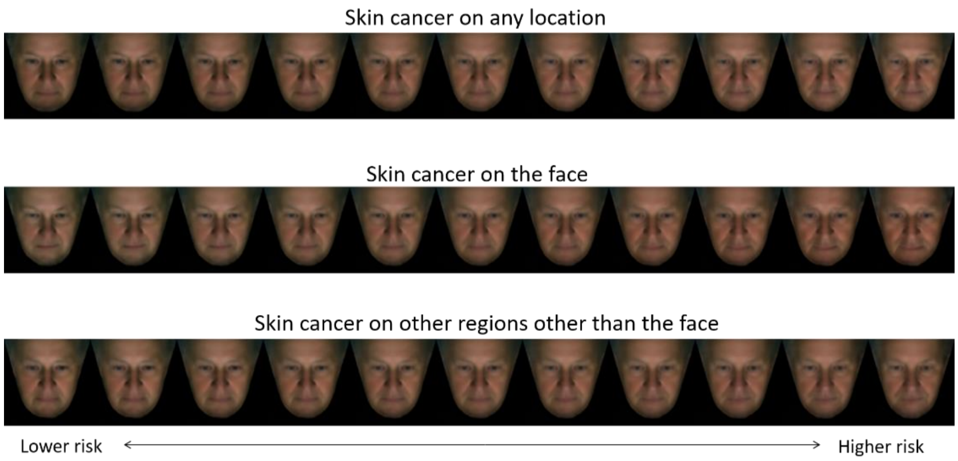


Figure 5: Explain facial features related to risk of developing skin cancer, by decoding statistically significant facial endophenotypes in the analysis. Results exhibit similar facial patterns for higher risk, such as a lower BMI and a more reddish face (especially for skin cancer on the face).

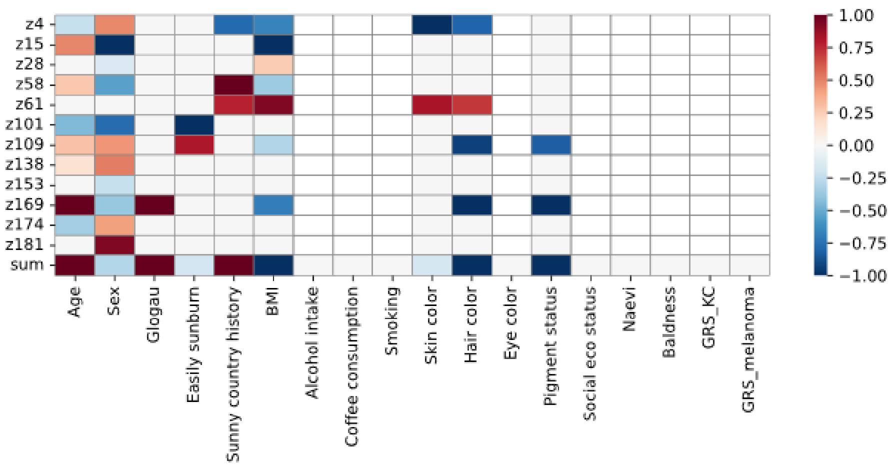


Figure 6: Statistically significant endophenotypes in skin cancer risk prediction are associated with known risk factors. X-axis: risk factors; Y-axis: index of facial endophenotypes which were statistically significant in skin cancer survival analysis, 'sum' means the sum of each column; The values of associations were normalized from -1 to 1 for each column. Red means a positive association, e.g., higher risk of skin cancer given a higher age.