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Research Interests

- Multi-omics Data Integration Methods Development
- Host-Microbe Interaction
- Aging and Neurodegenerative Diseases
- Maternal and Child Health
- Wearable Data and Precision Medicine
- Environmental Health

Education & Research Experiences

- **Nanyang Assistant Professor** 2024/5–present, **Nanyang Technological University, Singapore**
- **Postdoctoral Research Fellow** 2019/4–2024/4, **Stanford University**
  (Advisor: Prof. Michael Snyder)
- **Ph.D. in Bioinformatics and Metabolomics** 2013/9–2018/12, **Chinese Academy of Sciences**
  (Advisor: Prof. Zheng-Jiang Zhu)
- **B.S. in Biotechnology** 2009/9–2013/6, **Inner Mongolia University**

Honors & Awards

- Young Investigator Award **The 3rd Chinese American Society For Mass Spectrometry Conference** (2023)
- SPORR 2023 Rigor and Reproducibility Award **Stanford Program on Research Rigor and Reproducibility** (2023)
- Winner Selected by the Event Committee **Exposome Data Challenge Event** (2021)
- Student Travel Award for Oral Presentation **The International Metabolomics Society** (2018)
- International Conference Travel Award **The Metabolites Journal** (2018)
- China National Scholarship **Ministry of Education of the People's Republic of China** (2017)
- Award for Outstanding Youth Report **The 3rd China MS Analysis Conference** (2017)
- Merit Student **University of Chinese Academy of Sciences** (2016)
- Award for Outstanding Youth Report **The 34th China MS Society Conference** (2016)
- Inner Mongolia Outstanding Graduate **Inner Mongolia Autonomous Region** (2013)
- National Encouragement Scholarship **Inner Mongolia University** (2011)

First/Co-first Author Publications

+: Co-first Author. *: Co-Corresponding Author

1. X. Shen+, C. Wang+, X. Zhou, W. Zhou, D. Hornburg, S. Wu, and M.P. Snyder*, **Nonlinear Dynamic Changes During Human Aging Revealed in Multi-omics Profiles**. *Nature Aging* (accepted).

2. X. Zhou+, X. Shen+, J. Johnson, D. Spakowicz, M. Agnello, W. Zhou, M. Avina, A. Honkala, F. Chleilat, S. Chen, K. Cha, S. Leopold, C. Zhu, L. Chen, L. Lyu, D. Hornburg, S. Wu, X. Zhang, C. Jiang, L. Jiang, L. Jiang, R. Jian, A. Brooks, M. Wang, K. Contrepois, P. Gao, S. Rose, T. Tran, H. Nguyen, A. Celli, B. Hong, E. Bautista, Y. Dorsett, P. Kavathas, Y. Zhou, E. Sodergren, G.M. Weinstock, M.P. Snyder*. **Longitudinal Profiling of the Microbiome at Four Body Sites Reveals Core Stability and Individualized Dynamics During Health and Disease**. *Cell Host&Microbe*. 🔗

3. X. Shen+, R. Kellogg+, D. Panyard+, N. Bararpour+, K. Castillo, B. Lee-McMullen, A. Delfarah, J. Ubellecker, S. Ahadi, Y. Rosenberg-Hasson, A. Ganz, K. Contrepois, B. Michael, I. Simms, C. Wang, D. Hornburg, M.P. Snyder*, **Multi-omic Microsampling Captures Health Perturbations in A Lifestyle Context**. *Nature Biomedical Engineering*, 2023. 🔗

4. X. Shen+*, C. Wang+, M.P. Snyder*, **massDatabase: Utilities for the Operation of the Public Compound and Pathway Database**, *Bioinformatics*, 2022, btac546. 🔗

5. X. Shen+, W. Shao+, C. Wang+, L. Liang, S. Chen, S. Zhang, M. Rusu*, M.P. Snyder*, **Deep Learning-based Pseudo-Mass Spectrometry Imaging Analysis for Precision Medicine**, *Briefing in Bioinformatics*, 2022, bbac331. 🔗

6. X. Shen+, H. Yan+, C. Wang+, P. Gao, C.H. Johnson*, M.P. Snyder*, **TidyMass an Object-oriented Reproducible Analysis Framework for LC-MS Data**, *Nature Communications,* 2022, 4365. 🔗

7. P. Gao+, X. Shen+, X. Zhang, C. Jiang, M. P. Snyder*, **Precision Environmental Health Monitoring by Longitudinal Exposome and Multi-omics Profiling**, *Genome Research*, 2022, **32,** 1199-1214. 🔗

8. X. Shen+, S. Wu+, L. Liang, S. Chen, K. Contrepois, Z.-J. Zhu* and M.J. Snyder*, **metID: an R Package for Automatable Compound Annotation for LC−MS-based Data**, *Bioinformatics*, 2021, 1, 1-2. 🔗

9. X. Shen, R. Wang, X. Xiong, Y. Yin, Y. Cai, J. Ma, N. Liu, Z.-J. Zhu*, **Large-scale Metabolite Identification for Untargeted Metabolomics Using Metabolic Reaction Network**, *Nature Communications*, 2019, 10:1516. 🔗

10. X. Shen and Z.-J. Zhu*, **MetFlow: An Interactive and Integrated Workflow For Metabolomics Data Cleaning and Differential Metabolite Discovery**, *Bioinformatics*, 2019, 35, 16. 🔗

11. H. Jia+, X. Shen+, Y. Guan, M. Xu, M. Mo, J. Zhu* and Z.-J. Zhu*, **Predicting the Pathological Response to Neoadjuvant Chemoradiation Using Untargeted Metabolomics in Locally Advanced Rectal Cancer**, *Radiotherapy and Oncology*, 2018, 128, 548-556. 🔗

12. J. Wang+, T. Zhang+, X. Shen+, J. Liu, D. Zhao, Y. Sun, L. Wang, Y. Liu, X. Gong, Y. Liu, Z.-J. Zhu*, F. Xue*, **Serum Metabolomics for Early Diagnosis of Esophageal Squamous Cell Carcinoma by UHPLC-QTOF/MS**, *Metabolomics*, 2016, 12: 116. 🔗

13. X. Shen, X. Gong, Y. Cai, Y. Guo, J. Tu, T. Zhang, J. Wang, F. Xue, Z.-J. Zhu*, **Normalization and Integration of Large-Scale Metabolomics Data Using Support Vector Regression**, *Metabolomics*, 2016, 12: 89. 🔗

Collaborative Publications

1. C. Peng, Q. Chen, S. Tan, X. Shen, C. Jiang. **Generalized Reporter Score-based Enrichment Analysis for Omics Data**, *Briefings in Bioinformatics*, Volume 25, Issue 3, May 2024, bbae116. 🔗

2. D. Ding, X. Shen, M.P. Snyder, R. Tibshirani, **Semi-supervised Cooperative Learning for Multiomics Data Fusion**, Machine Learning for Multimodal Healthcare Data. ML4MHD 2023. *Lecture Notes in Computer Science*, vol 14315. Springer, Cham. 🔗

3. S. Jain, L. Pei, J. Spraggins, M. Angelo, J. Carson, N. Gehlenborg, F. Ginty, J. Gonçalves, J. Hagood, J. Hickey, N. Kelleher, L. Laurent, S. Lin, Y. Lin, H. Liu, A. Naba, E. Nakayasu, W. Qian, A. Radtke, P. Robson, B. Stockwell, R. Plas, I. Vlachos, M. Zhou, HuBMAP Consortium, K. Borner, M. Snyder, **HuBMAP Consortium, Advances and Perspectives for the Human BioMolecular Atlas Program (HuBMAP)**, *Nature Cell Biology*, 2023. ⌀

4. W. Wei, N. Riley, X. Lyu, X. Shen, J. Guo, S. Raun, M. Zhao, M. Moya-Garzon, H. Basu, A. Tung, V. Li, W. Huang, A. Wiggenhorn, K. Svensson, M. Snyder, C. Bertozzi, J. Long, **Organism-wide, Cell-type-specific Secretome Mapping of Exercise Training in Mice**, *Cell Metabolism*, 35: 1-19, 2023. ⌀

5. S. Zhang, J. Cooper-Knock, A. Weimer, M. Shi, L. Kozhaya, D. Unutmaz, C. Harvey, T. Julian, S. Furini, E. Frullanti, F. Fava, A. Renieri, P. Gao, X. Shen, I. Timpanaro, K. Kenna, J. Baillie, M. Davis, P. Tsao, M.P. Snyder, **Multiomic Analysis Reveals Cell-type-specific Molecular Determinants of COVID-19 Severity**, *Cell Systems*, 13(8):598-614, 2022. ⌀

6. L. Maitre, J. Guimbaud, C. Warembourg, N. Güil-Oumrait, P. Petrone, M. Chadeau-Hyam, M. Vrijheid, X. Basagaña, J. Gonzalez, Exposome Data Challenge Participant Consortium, **State-of-the-art methods for exposure-health studies: Results from the exposome data challenge event**, *Environment International*, 168: 107422, 2022. ⌀

7. M. Wei, L. Zhao, J. Lv, X. Li, G. Zhou, B. Fan, X. Shen, D. Zhao, F. Xue, J. Wang, T. Zhang, **The Mediation Effect of Serum Metabolites On The Relationship Between Long-Term Smoking Exposure and Esophageal Squamous Cell Carcinoma**, *BMC cancer*, 21, 415. ⌀

8. J. Lv, J. Wang, X. Shen, J. Liu, D. Zhao, X. Li, B. Fan, Y. Sun, F. Xue, Z.-J. Zhu, T. Zhang, **A Serum Metabolomics Analysis Reveals A Panel of Screening Metabolic Biomarkers for Esophageal Squamous Cell Carcinoma**, *Clinical and Translational Medicine*, 2021, 11, 5. ⌀

9. X. Li, L. Zhao, M. Wei, J. Lv, Y. Sun, X. Shen, D. Zhao, F. Xue, T. Zhang, J. Wang, **Serum Metabolomics Analysis for The Progression of Esophageal Squamous Cell Carcinoma**, *Journal of Cancer*, 2021, 12, 3190–3197. ⌀

10. L. Liang, M. Rasmussen, B. Piening, X. Shen, S. Chen, H. Rost, J. Snyder, R. Tibshirani, L. Skotte, N. Lee, K. Contrepois, B. Feenstra, H. Zackriah, M.J. Snyder, M. Melbye, **Metabolic Dynamics and Prediction of Gestational Age and Time to Delivery in Pregnant Women**, *Cell*, 2020, 181, 7, 1680-1692. ⌀

11. Z. Wang, B. Cui, F. Zhang, Y. Yang, X. Shen, Z. Li, W. Zhao, Y. Zhang, K. Deng, Z. Rong, K. Yang, X. Yu, K. Li, P. Han, and Z.-J. Zhu, **Development of A Correlative Strategy to Discover Colorectal Tumor Tissue Derived Metabolite Biomarkers in Plasma Using Untargeted Metabolomics**, *Analytical Chemistry*, 2019, 91, 3, 2401-2408. ⌀

12. Z. Zhou, X. Shen, X. Chen, J. Tu, X. Xiong, and Z.-J. Zhu, **LipidIMMS Analyzer: Integrating Multi-dimensional Information to Support Lipid Identification in Ion Mobility–Mass Spectrometry based Lipidomics**, *Bioinformatics*, 2018, 35, 4, 698-700. ⌀

13. Z. Zhou, J. Tu, X. Xiong, X. Shen, and Z.-J. Zhu, **LipidCCS: Prediction of Collision Cross-Section Values for Lipids with High Precision to Support Ion Mobility-Mass Spectrometry based Lipidomics**, *Analytical Chemistry*, 2017, 89, 9559–9566. ⌀

14. Z. Zhou, X. Shen, J. Tu, and Z.-J. Zhu, **Large-Scale Prediction of Collision Cross-Section Values for Metabolites in Ion Mobility-Mass Spectrometry**, *Analytical Chemistry*, 2016, 88, 11084-11091. ⌀

Submitted Publications

1. X. Shen[+,*], P. Gao, X. Zhang, **Decoding Links Between the Exposome and Health Outcomes by Multi-omics Analysis. Submitted.**

2. X. Shen[+*], M.P. Snyder[*], **microbiomeDataset: A Tidyverse-style Framework for Organizing and Processing Microbiome Data**. **Submitted**.

3. S. Chen[+], X. Shen[+], L. Liang[+], M. P. Snyder[*], **Longitudinal Urine Metabolic Profiling and Gestational Age Prediction in Pregnancy**. Submitted to ***Briefing in Bioinformatics***. 🔗

4. S. Chen[+], G. Wang[+], X. Shen[+], D. Hornburg, S. Rego, R. Hoffman, S. Nevins, X. Cheng, M.P. Snyder[*], **Integration and Comparison of Multi-omics Profiles of NGLY1 Deficiency Plasma and Cellular Models to Identify Clinically Relevant Molecular Phenotypes**. Submitted to ***Clinical and Translational Medicine***. 🔗

Patents

1. M.P. Snyder, R. Kellogg, X. Shen, **Multi-Omic Sample Analysis Methods**, 2022, USA.

2. L. Liang, M.P. Snyder, X. Shen, S. Chen, **Systems and Methods for Evaluating Gestational Progress and Applications Thereof**, 2023, 18251702, USA.

3. Z-J. Zhu, X. Shen, **A Method for Metabolite Annotation and Dysregulated Pathway Analysis**, 2019, China.

Invited Presentations

1. **Dynamic Changes During Human Aging Revealed in Multi-omics Profiles. 2024 Chinese Biophysics Congress,** 2024/7, Lanzhou, China.

2. **Multi-omics For Precision Medicine. Hong Kong Baptist University,** 2024/7, Hong Kong, China.

3. **Multi-omics For Precision Medicine. Metabolomics in Human Health,** 2024/5, Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore.

4. **R for Mass Spectrometry Data Processing. CAS Center for Excellence in Molecular Plant Sciences.** 2024/5, Shanghai, China.

5. **Multi-omics For Precision Medicine. Interdisciplinary Research Center on Biology and Chemistry,** 2024/3, Shanghai, China.

6. **Remote and Flexible Microsampling Multi-omics for Precision Medicine. The iPOP Summit 2023**. 2023/4, Stanford University, USA.

7. **Bioinformatics Algorithm Development for Mass Spectrometry Data and its Application to Precision Medicine. University of Colorado.** 2023/4, Denver, Colorado, USA.

8. **Bioinformatics Algorithm Development for Mass Spectrometry Data and its Application to Precision Medicine. University of Minnesota.** 2023/4, Twin Cities, Minnesota, USA.

9. **Bioinformatics Algorithm Development for Mass Spectrometry Data and its Application to Precision Medicine. University of Connecticut.** 2023/3, Storrs, Connecticut, USA.

10. **Bioinformatics Algorithm Development for Mass Spectrometry Data and its Application to Precision Medicine. Altos Labs.** 2023/3, Redwood City, USA.

11. **Bioinformatics Algorithm Development for Mass Spectrometry Data and its Application to Precision Medicine. Ohio State University.** 2023/2, Columbus, USA.

12. **Bioinformatics Method Development for Mass Spectrometry and its Application to Precision Medicine**. **Stanford CVI Early Career Research Roundtable**, 2022/11, Stanford, USA.

Oral Presentations

1. **Nonlinear Dynamic Changes During Human Aging Revealed in Multi-omics Profiles. Bay Area Metabolism Meeting (BAMM) 2023**, 2023/9, Palo Alto, USA.

2. **Multi-omics Microsampling for The Profiling of Lifestyle-Associate Changes in Health. The 3rd Chinese American Society for Mass Spectrometry Conference**, 2023/8, Virtual meeting.

3. **Multi-omics Microsampling for The Profiling of Lifestyle-Associate Changes in Health. The 71th American Society for Mass Spectrometry Conference**, 2023/6, Houston, USA.

4. **Multi-omics Microsampling for The Profiling of Lifestyle-Associate Changes in Health. Invited presentation,** 2023/2, Huazhong University of Science and Technology, China.

5. **Multi-omics Microsampling for The Profiling of Lifestyle-Associate Changes in Health. Stanford Postdoc Symposium,** 2023/2, Stanford, USA.

6. **Deep Learning-based Pseudo-Mass Spectrometry Imaging Analysis for Precision Medicine**. **CASMS Virtual Conference**, 2022/10, Virtual meeting.

7. **TidyMass: An Object-oriented Reproducible Analysis Framework for LC-MS Data**. **ACS Fall 2022**, 2022/8, Virtual meeting.

8. **metID: an R Package for Automatable Compound Annotation for LC−MS-based Data**. **The 69th American Society for Mass Spectrometry Conference**, 2021/11, Philadelphia, USA.

9. **Decoding Links Between the Exposome and Health Outcomes by Multi-omics Analysis**. **Exposome Data Challenge Event**, 2021/4, Virtual meeting.

10. **Metabolic Reaction Network-based Recursive Metabolite Identification for Untargeted Metabolomics**. **The 14th International Conference of the Metabolomics Society**, 2018/6, Seattle, USA.

11. **Assessment of the Response to Neoadjuvant Chemo-Radiation in Rectal Cancer Patients based on a Metabolomics Approach**. **The 3rd China Mass Spectrometry Analysis Conference**, 2017/12, Xiamen, China.

12. **Normalization and Integration of Large-Scale Mass Spectrometry-based Metabolomics Data Using Support Vector Regression**. **The 34th China Mass Spectrometry Society Conference**, 2016/9, Xining, China.

13. **Normalization and Integration of Large-Scale MS-based Metabolomics Data Using Support Vector Regression**. **The 64th American Society for Mass Spectrometry Conference**, 2016/6, San Antonio, USA.

Poster Presentations

1. **Nonlinear Dynamic Changes During Human Aging Revealed in Multi-omics Profiles. The 72nd American Society for Mass Spectrometry Conference**, 2024/6, Anaheim, California, USA.

2. **Nonlinear Dynamic Changes During Human Aging Revealed in Multi-omics Profiles. Stanford Bio-X Interdisciplinary Initiatives Seed Grants Program Symposium 2023.** 2023/9, Stanford, USA.

3. **TidyMass An Object-oriented Reproducible Analysis Framework for LC-MS Data**. **Stanford Data Science Conference**, 2023/5, Stanford University, USA.

4. **Deep Learning-based Pseudo-Mass Spectrometry Imaging Analysis for Precision Medicine**. **Stanford Genetics Retreat 2022**, 2022/9, Monterey, USA.

5. **Deep Learning-based Pseudo-Mass Spectrometry Imaging Analysis for Precision Medicine**. **Bay Area Metabolism Meeting (BAMM) 2022**, 2022/9, Palo Alto, USA.

6. **TidyMass An Object-oriented Reproducible Analysis Framework for LC-MS Data**. **The 70th American Society for Mass Spectrometry Conference**, 2022/6, Minneapolis, USA.

7. **Longitudinal Interactions Between Levels of Serum Cytokine and the Microbiome from Four Body Sites**. **IMMUNOLOGY2022**, 2022/5, Portland, USA.

8. **TidyMass An Object-oriented Reproducible Analysis Framework for LC-MS Data**. **Stanford Genetics Retreat 2021**, 2021/9, Palo Alto, USA.

9. **Longitudinal Urine Metabolic Profiling and Gestational Age Prediction in Pregnancy**. **The 17th International Conference of the Metabolomics Society**, 2020/6, Virtual meeting.

10. **Metabolic Reaction Network based Metabolite Annotation in Untargeted Metabolomics**. **The 13th International Conference of the Metabolomics Society**, 2017/6, Brisbane, Austria.

Teaching

- **LC-MS Data Processing and Analysis Using R language** 2022/9, **Biotree Company**
  Responsibilities: Lecture

- **R Language for Reproducible Data Analysis** 2020/4, **SCPA**
  Responsibilities: Lecture

- **Stanford School of Medicine Intern** 2019/8–Present, **Stanford University**
  Responsibilities: Mentor

- **Mass Spectrometry Analysis** 2014/9–2014/12, **Chinese Academy of Sciences**
  Responsibilities: Guest lecturer

Volunteering

- **Member of Editorial Board** 2023/8-present, **npj Women's health**
- **Member of Youth Editorial Board** 2023/2–present, **Phenomics**
- **Member of Youth Editorial Board** 2023/1–present, **Brain-X**
- **Member of Youth Editorial Board** 2022/7–present, **iMeta**
- **Co-chair** 2021/7–2022/8, **Stanford Chinese Postdoctoral Association**
- **Organizer** 2020/2–2021/12, **Stanford Chinese Postdoctoral Oral Presentation Improvement**
- **Member** 2019/7–2021/7, **Stanford Chinese Postdoctoral Association**

Journal Referee

- *Nature Biotechnology, Nature Communications, Briefing in Bioinformatics, Bioinformatics, GigaScience, PLOS one, Phytochemistry, Genomics,Proteomics&Bioinformatics, Communications Chemistry, Communications Biology, Frontiers Molecular Biosciences, iMeta, Proteomics, BMC Bioinformatics, Proteomics*

Referrers

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