

Apr 16, 2024

Version 2

CODA: 3D tissue reconstruction pipeline | HuBMAP | JHU-TMC V.2

DOI

<https://dx.doi.org/10.17504/protocols.io.kqdg324xpv25/v2>

Kyu Sang Han¹, Pei-Hsun Wu¹, Joel Sunshine², Ashley Kiemen², Sashank Reddy², Denis Wirtz^{1,2}

¹Johns Hopkins University; ²Johns Hopkins Medicine

Human BioMolecular Atlas Program (HuBMAP) Method Development Community

Tech. support email: Jeff.spraggins@vanderbilt.edu



Kyu Sang Han

Johns Hopkins University

Create & collaborate more with a free account

Edit and publish protocols, collaborate in communities, share insights through comments, and track progress with run records.

Create free account

OPEN  ACCESS



DOI: <https://dx.doi.org/10.17504/protocols.io.kqdg324xpv25/v2>

Protocol Citation: Kyu Sang Han, Pei-Hsun Wu, Joel Sunshine, Ashley Kiemen, Sashank Reddy, Denis Wirtz 2024. CODA: 3D tissue reconstruction pipeline | HuBMAP | JHU-TMC. **protocols.io**

<https://dx.doi.org/10.17504/protocols.io.kqdg324xpv25/v2> Version created by [Kyu Sang Han](#)

Manuscript citation:

A.M. Braxton, A.L. Kiemen, M.P. Grahm, A. Forjaz, J. Parksong, J.M. Babu, J. Lai, L. Zheng, N. Niknafs, L. Jiang, H. Cheng, Q. Song, R. Reichel, S. Graham, A.I. Damanakis, C.G. Fischer, S. Mou, C. Metz, J. Granger, X.-D. Liu, N. Bachmann, Y. Zhu, Y.Z. Liu, C. Almagro-Pérez, A.C. Jiang, J. Yoo, B. Kim, S. Du, E. Foster, J.Y. Hsu, P.A. Rivera, L.C. Chu, D. Liu, E.K. Fishman, A. Yuille, N.J. Roberts, E.D. Thompson, R.B. Scharpf, T.C. Cornish, Y. Jiao, R. Karchin, R.H. Hruban, P.-H. Wu, D. Wirtz, and L.D. Wood, "3D genomic mapping reveals multifocality of human pancreatic precancers", *Nature* (2024)

A.L. Kiemen, A. Forjaz, R. Sousa, K. Sang Han, R.H. Hruban, L.D. Wood, P.H. Wu, and D. Wirtz, "High-resolution 3D printing of pancreatic ductal microanatomy enabled by serial histology", *Advanced Materials Technologies* 9, 2301837 (2024)

T. Yoshizawa, J. W. Lee, S.-M. Hong, D.J. Jung, M. Noe, W. Sbijewski, A. Kiemen, P.H. Wu, D. Wirtz, R.H. Hruban, L.D. Wood, and K. Oshima. "Three-dimensional analysis of ductular reactions and their correlation with liver regeneration and fibrosis", *Virchows Archiv* (2023).

A.L. Kiemen, A.I. Damanakis, A.M. Braxton, J. He, D. Laheru, E.K. Fishman, P. Chames, C. Almagro Perez, P.-H. Wu, D. Wirtz, L.D. Wood, and R. Hruban, "Tissue clearing and 3D reconstruction of digitized, serially sectioned slides provide novel insights into pancreatic cancer", *Med* 4, 75-91 (2023)

A. Kiemen, Y. Choi, A. Braxton, C. Almagro Perez, S. Graham, M. Grahm, N., N. Roberts, L. Wood, P. Wu, R. Hruban, and D. Wirtz, "Intraparenchymal metastases as a cause for local recurrence of pancreatic cancer", *Histopathology* 82: 504-506 (2022)

A.L. Kiemen, A.M. Braxton, M.P. Grahm, K.S. Han, J.M. Babu, R. Reichel, A.C. Jiang, B. Kim, J. Hsu, F. Amoa, S. Reddy, S.-M. Hong, T.C. Cornish, E.D. Thompson, P. Huang, L.D. Wood, R.H. Hruban, D. Wirtz and P.H. Wu, "CODA: quantitative 3D reconstruction of large tissues at cellular resolution", *Nature Methods* 19: 1490-1499 (2022)

K.S.Han, I. Sander, J. Kumer, E. Resnick, C. Booth, B. Starich, J. Walston, A.L. Kiemen, S. Reddy, C. Joshu, J. Sunshine, D. Wirtz, P.-H. Wu "The microanatomy of human skin in aging." *bioRxiv* (2024): 2024-04.

License: This is an open access protocol distributed under the terms of the **Creative Commons Attribution License**, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited

Protocol status: Working

We use this protocol and it's working

Created: April 16, 2024

Last Modified: April 16, 2024

Protocol Integer ID: 98297

Keywords: CODA, deeplearning, semanticsegmentation, tissuemapping, annotation, machinelearning, tmc coda pipeline, tmc coda, tissue, hubmap, coda, tmc, 3d

Funders Acknowledgements:

Institute of Arthritis and Musculoskeletal and Skin Diseases

Grant ID: U54AR081774

National Cancer Institute

Grant ID: U54CA143868

Abstract

CODA pipeline with 6 parts



Setting up CODA environment and preparing sample dataset

1 dx.doi.org/10.17504/protocols.io.q26g71rpkgwz/v1

Calculate registration on low-resolution tissue images

2 dx.doi.org/10.17504/protocols.io.kxygxy3dl8j/v1

Deep learning multi-labelling of tissue structures using training on manual annotations

3 dx.doi.org/10.17504/protocols.io.81wgbz1x3gpk/v1

Register the deep learning labelled images and Construct 3D tissue matrix

4 dx.doi.org/10.17504/protocols.io.yxmvme7eog3p/v1

Nuclear coordinate generation

5 dx.doi.org/10.17504/protocols.io.dm6gpz8z8lzp/v1

Register the nuclear coordinates and Construct 3D cell matrix

6 dx.doi.org/10.17504/protocols.io.n2bvjnrnxgk5/v1