Creating the Human Organ Atlas with HiP-CT

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HiP-CT


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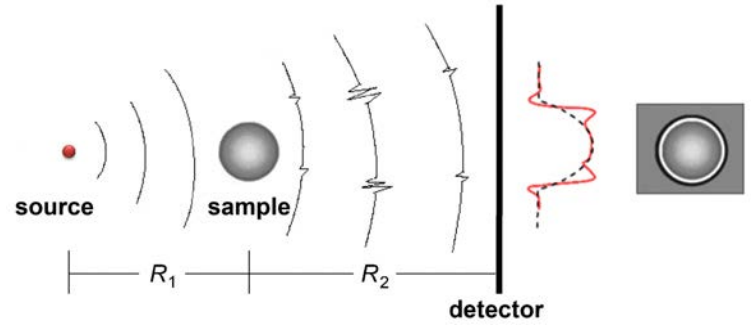
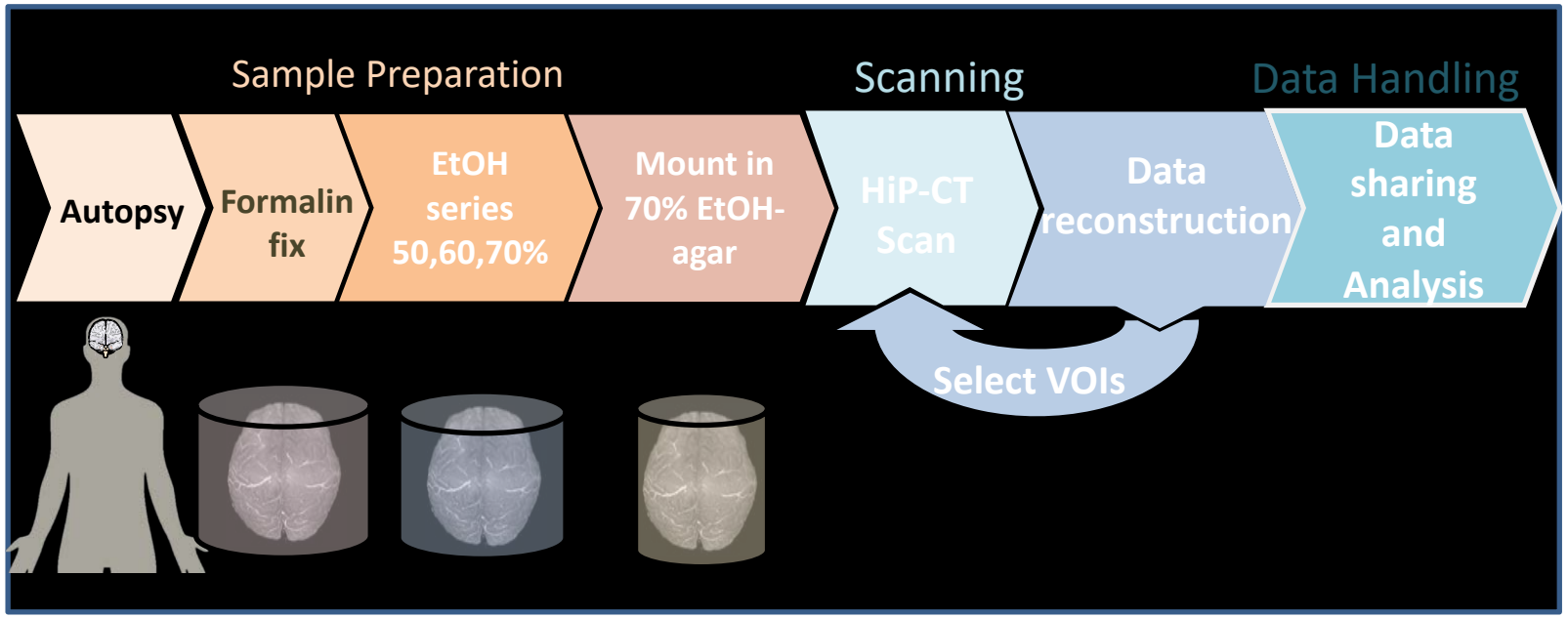
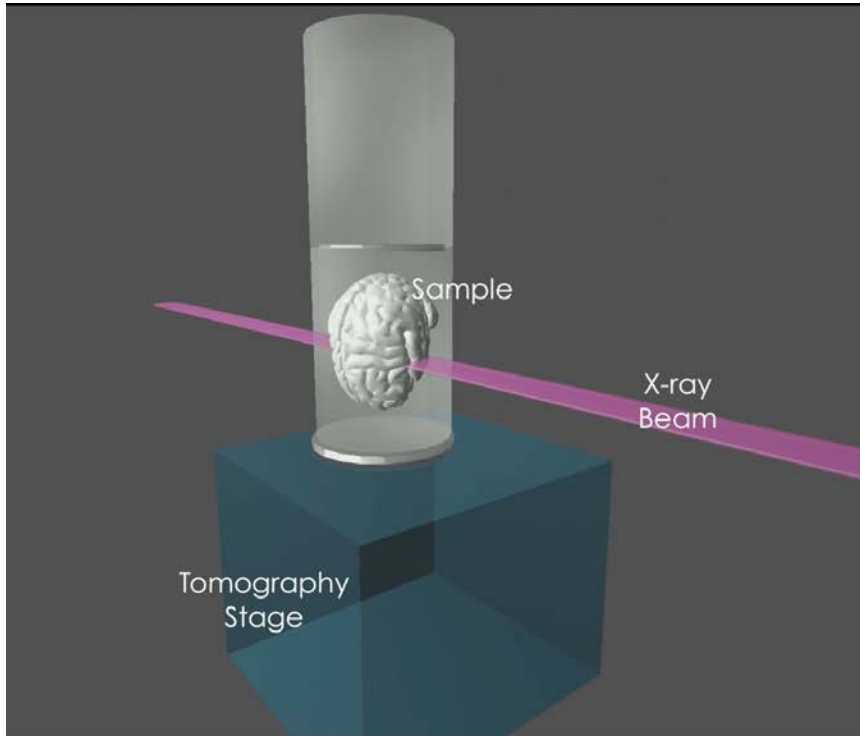
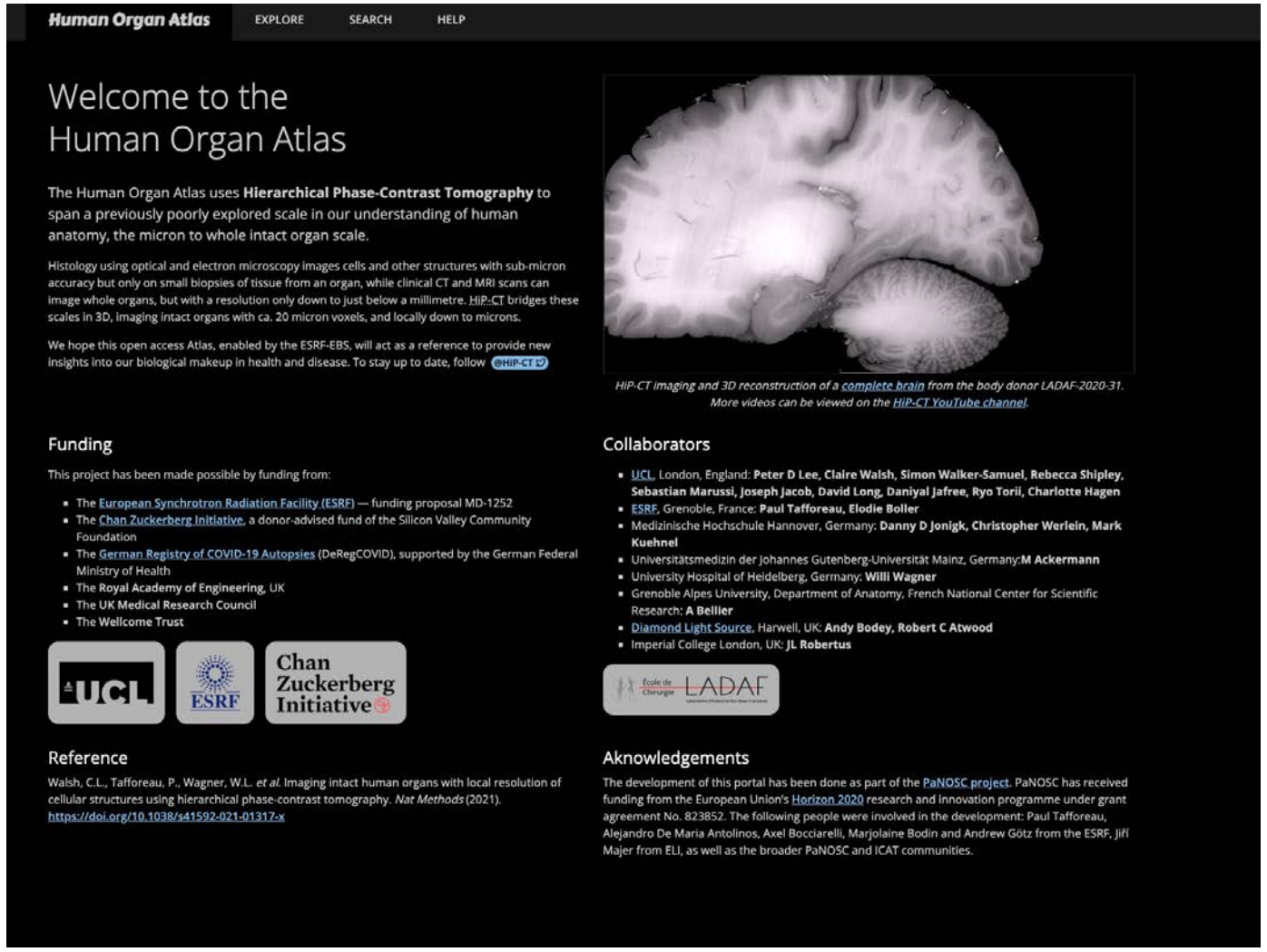

source
sample
R_1
R_2
detector


Sample Preparation
Scanning
Data Handling
Autopsy
Formalin fix
EtOH series 50,60,70%
Mount in 70% EtOH-agar
HiP-CT Scan
Data reconstruction
Data sharing and Analysis
Select VOIs


Sample
X-ray Beam
Tomography Stage

The HOA



https://human-organ-atlas.esrf.eu

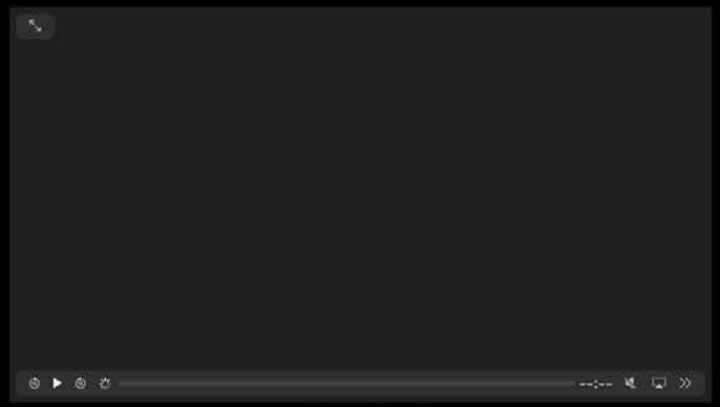
photon and neutron open science cloud

Welcome to the Human Organ Atlas

The Human Organ Atlas uses **Hierarchical Phase-Contrast Tomography** to span a previously poorly explored scale in our understanding of human anatomy, the micron to whole intact organ scale.

Histology using optical and electron microscopy images cells and other structures with sub-micron accuracy but only on small biopsies of tissue from an organ, while clinical CT and MRI scans can image whole organs, but with a resolution only down to just below a millimetre. HiP-CT bridges these scales in 3D, imaging intact organs with ca. 20 micron voxels, and locally down to microns.

We hope this open access Atlas, enabled by the ESRF-EBS, will act as a reference to provide new insights into our biological makeup in health and disease. To stay up to date, follow @HiP-CT



HiP-CT imaging and 3D reconstruction of a complete brain from the body donor LADAF-2020-31. More videos can be viewed on the HiP-CT YouTube channel.

Funding

This project has been made possible by funding from:

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- The **UK Medical Research Council**
- The **Wellcome Trust**

Collaborators

- UCL, London, England: **Peter D Lee, Claire Walsh, Simon Walker-Samuel, Rebecca Shipley, Sebastian Marussi, Joseph Jacob, David Long, Daniyal Jafree, Ryo Torii, Charlotte Hagen**
- ESRF, Grenoble, France: **Paul Tafforeau, Elodie Boller**
- Medizinische Hochschule Hannover, Germany: **Danny D Jonigk, Christopher Werlein, Mark Kuehnel**
- Universitätsmedizin der Johannes Gutenberg-Universität Mainz, Germany:**M Ackermann**
- University Hospital of Heidelberg, Germany: **Willi Wagner**
- Grenoble Alpes University, Department of Anatomy, French National Center for Scientific Research: **A Bellier**
- Diamond Light Source, Harwell, UK: **Andy Bodey, Robert C Atwood**
- Imperial College London, UK: **JL Robertus**

Reference

Walsh, C.L., Tafforeau, P., Wagner, W.L. *et al.* Imaging intact human organs with local resolution of cellular structures using hierarchical phase-contrast tomography. *Nat Methods* (2021). https://doi.org/10.1038/s41592-021-01317-x

Aknowledgements

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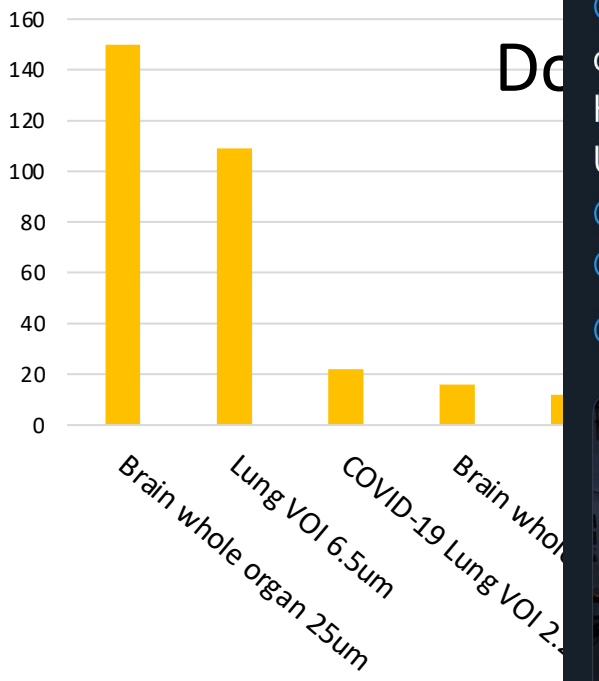
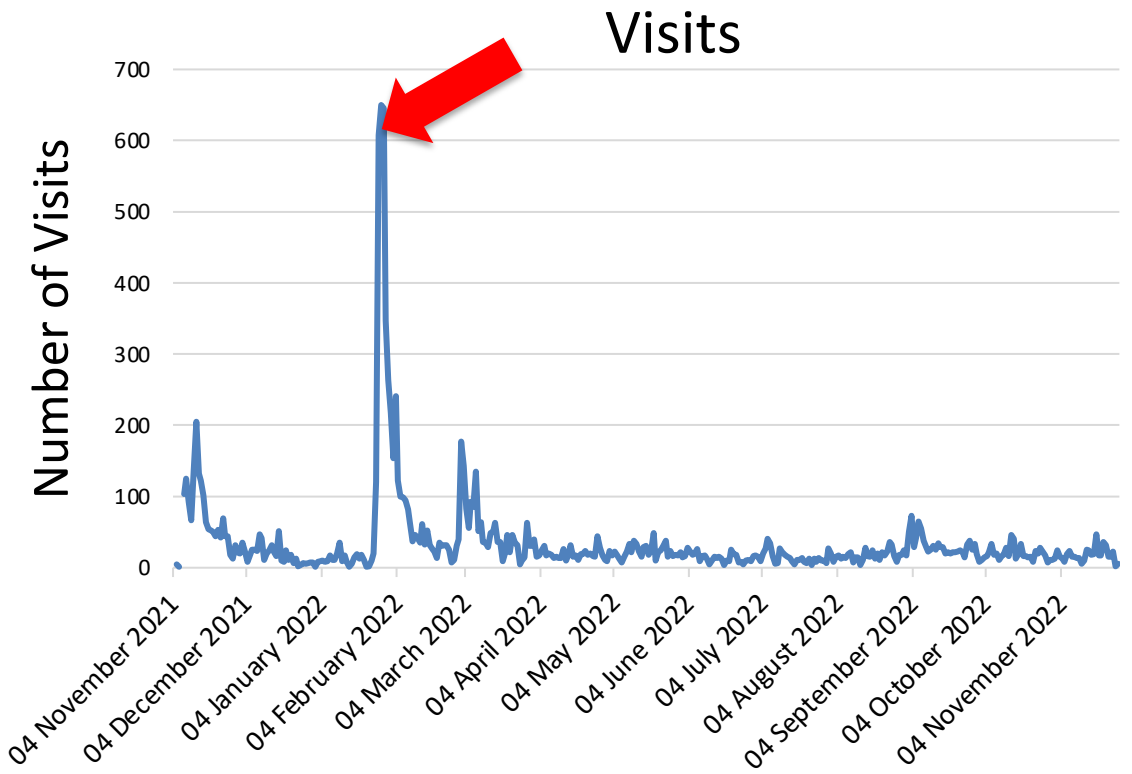
Figures from the portal





Case Study of Data Use

TINC: Tree-structured Implicit Neural Compression

Runzhao Yang, Tingxiong Xiao, Yuxiao Cheng, Jinli Suo, Qionghai Dai
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Abstract

Implicit neural representation (INR) can describe the target scenes with high fidelity using a small number of parameters, and is emerging as a promising data compression techniaue. However, INR in intrinsically of limited spec-

28]. Due to its powerful representation capability, INR can describe nature scenes at high fidelity with a much smaller number of parameters than raw discrete grid representation, and thus serves as a promising data compression technique.

In spite of the big potential, INR based compression is

SCI: A Spectrum Concentrated Implicit Neural Compression for Biomedical Data

Runzhao Yang[1], Tingxiong Xiao[1], Yuxiao Cheng[1], Qianni Cao[2], Jinyuan Qu[1], Jinli Suo[13], Qionghai Dai[1]

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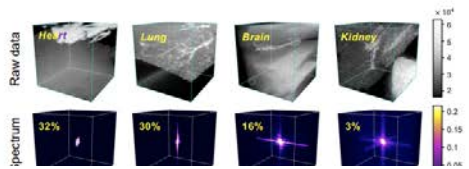
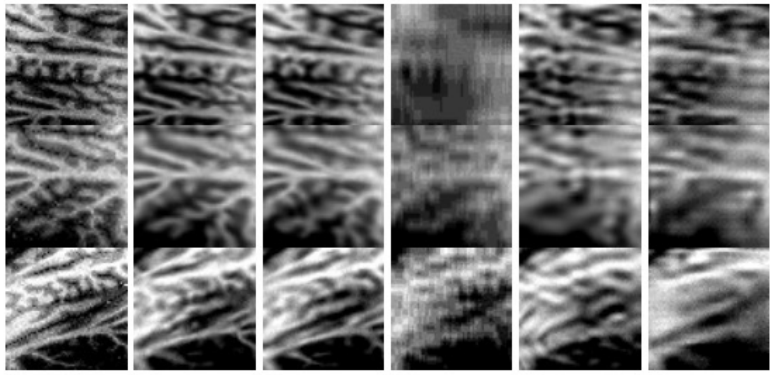
[3]jlsuo@tsinghua.edu.cn

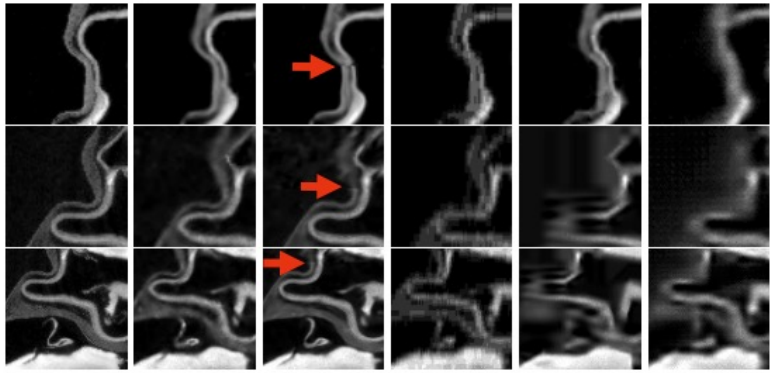
Abstract

Massive collection and explosive growth of biomedical data, demands effective compression for efficient storage, transmission and sharing. Readily available visual data compression techniques have been studied extensively but tailored for natural images/videos, and thus show limited performance on biomedical data, which are of





(a) Three ROIs from *Brain* data; compression ratio: ~87×

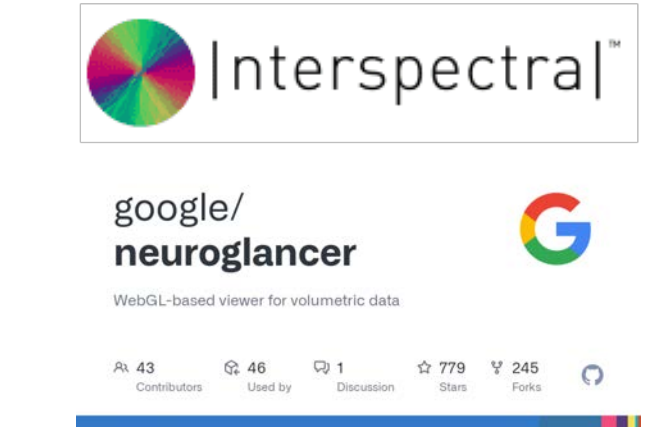


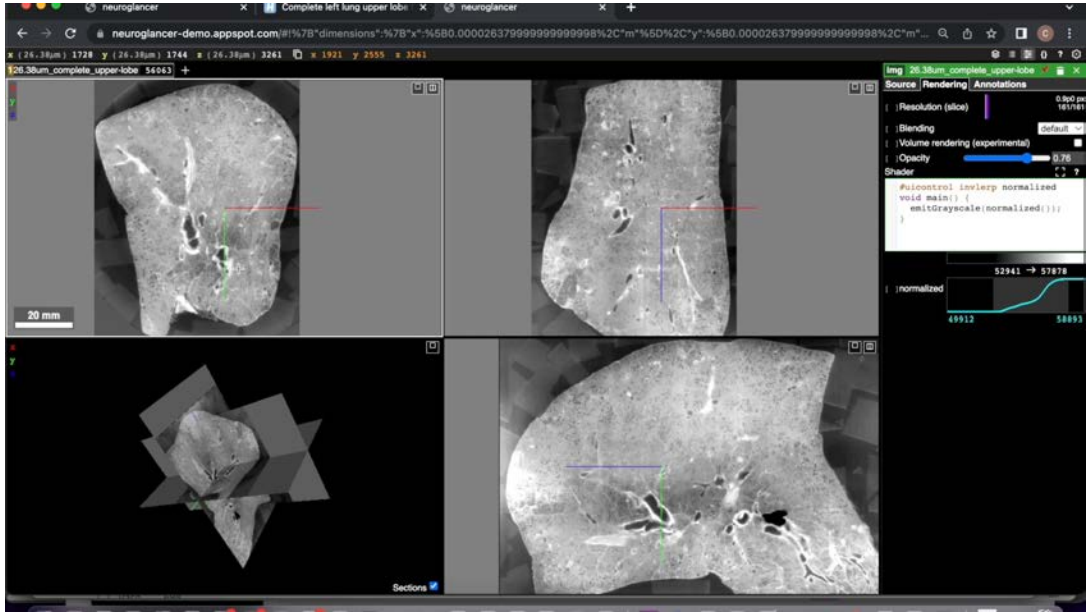
(b) Three ROIs from *Heart* data; compression ratio: ~87×

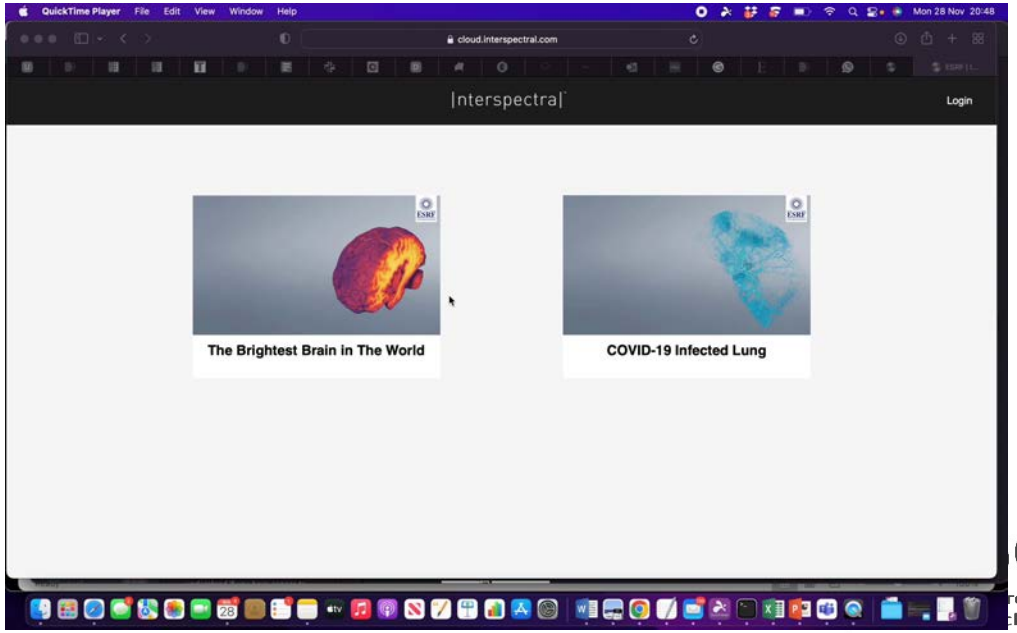
Ground Truth TINC (ours) SCI NeRV HEVC SGA+BB

Visualization

- Visualize before download
- Increase accessibility
- Who are the users what do they need?
- Testing Integration of Interspectral and Neuroglancer
- Highlighted data curation process flaws that we have to fix.



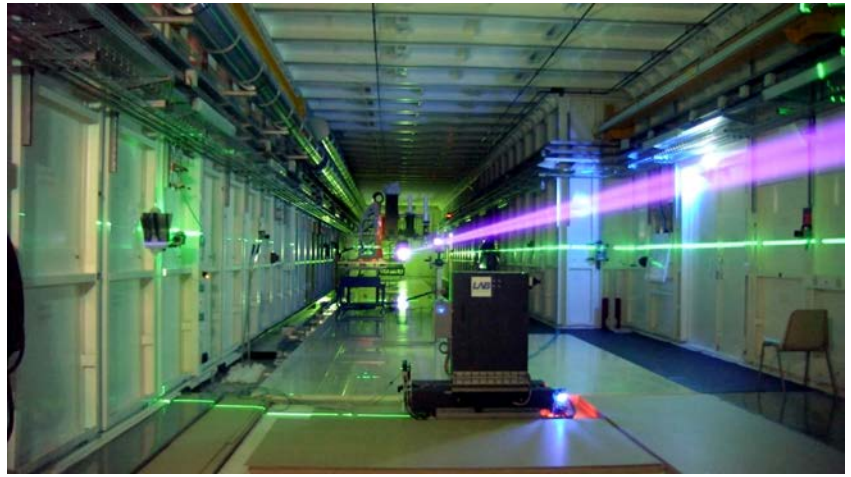




Big increase in data production

BM05

BM18



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The Data

We are now routinely producing 1TB per/hr (raw data)

Latest intact organ data sets are 10x larger than before - 805GB for a single organ in JP2000 compressed form

- Imaging at 3 resolutions:
- Final image sizes are in JPG2000 with compression x10
  - Whole organ @18-25µm: **5-80GB**
  - Region of interest @6µm : **20-100GB**
  - Region of interest @1-2.5µm: **20-150GB**
- **Entire multiresolution datasets can be >1.5TB**

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We are expanding

Town Hall Meeting: Proposal for a Human Organ Atlas Hub at ESRF

16:00 EU time, 15:00UK, Dec. 2nd, via Zoom

Register at https://bit.ly/HiP-CT-Workshop01

Summary

- We have made the HOA open to many
- Data is being used and resulting in publications – Very Cool!
- Enabling visualization will make it more accessible (we are told) – interaction with cloud based object storage at affordable prices, this is challenging.
- We plan to release more data but data curation pipelines are HARD! – Help needed
- We are growing, how do we expand to keep pace with expanding interest and expanding datasets?

ESRF

UCL

Royal Academy of Engineering

MRC Medical Research Council

BBSRC bioscience for the future

Research Complex at Harwell

diamond

Chan Zuckerberg Initiative

wellcome

Thank you

Contact details c.walsh.11@ucl.ac.uk

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