bioretics
BEYOND EXPERIENCE

2ND ANNUAL CANADA-ITALY BUSINESS FORUM
ON ARTIFICIAL INTELLIGENCE
November 18 – 20, 2020

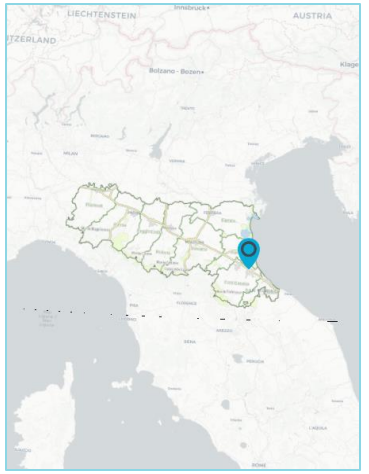
Italian Chamber of Commerce
In Canada

The Brain Initiative imaging and analysis techniques to construct a cell census atlas of the human brain

Small R&D company
Founded in 2012
Headquarter in Cesena
8 people
~500k euro revenue
High profitability ratios
4+ int. Patents
3+ Trademarks
Internship program

Matteo ROFFILLI

roffilli@gmail.com
www.bioretics.com



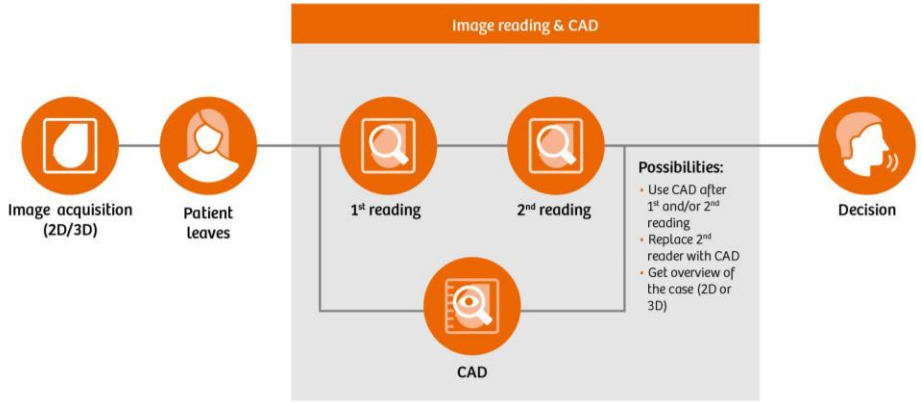
The old-school

bioretics
BEYOND EXPERIENCE

Digital Mammography

Galileo

- The first pioneering project for Computer Aided Detection in Digital Mammography based on Machine Learning dates to 1999
- Now Galileo is in production in over 130 medical facilities around the world
- **(IPR)** R. Campanini, M. Roffilli , N. Lanconelli: United States Patent Application 10/231,800 "**Method, and corresponding apparatus, for automatic detection of regions of interest in digital images of biological tissue**"
- Megabytes to process, CPU single core, Beowulf cluster
- Acquired skills for the management of **anonymized** data

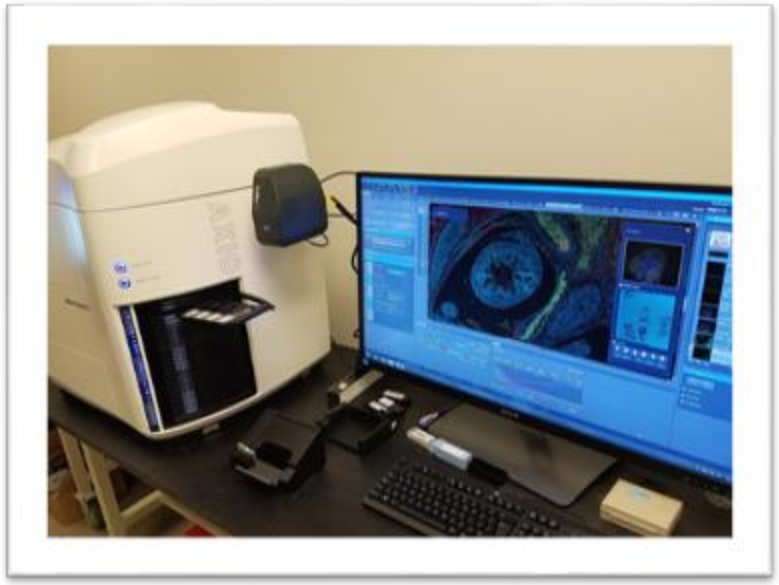


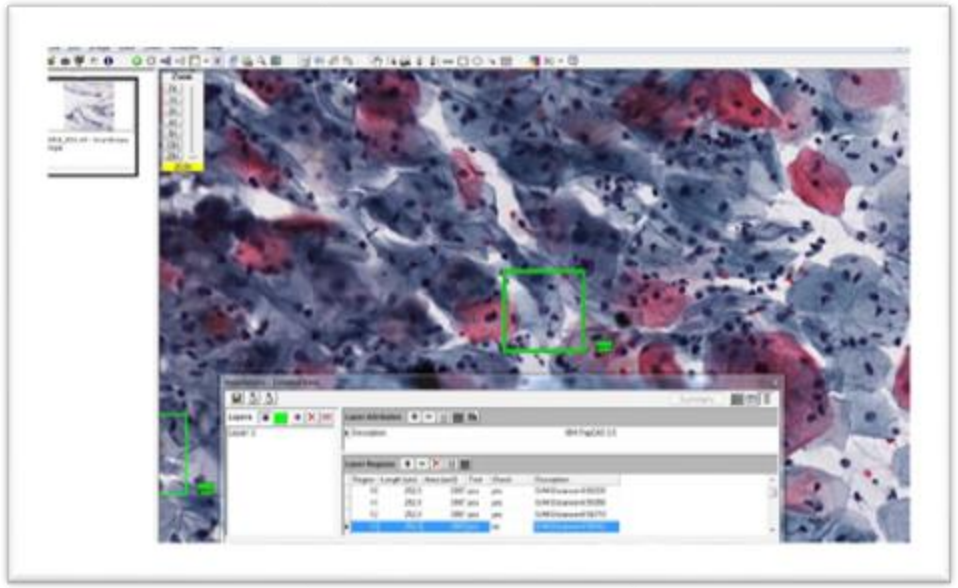
roffilli@gmail.com

The vision for the future

bioretics
BEYOND EXPERIENCE

Digital Pathology





In 2008 and 2011 with Digital Pathology we moved to life sciences and scaled up our Machine Learning algorithms to 300+ GB per patient.

The prototypes were developed for IBM Italy as part of the projects:

- MIACell (Medical Image Analysis on Cell BroadBand Engine)
- PAPCAD 2.0 ICT PROJECT SIAI101

The new frontiers

Human Brain Discovery

with LENS

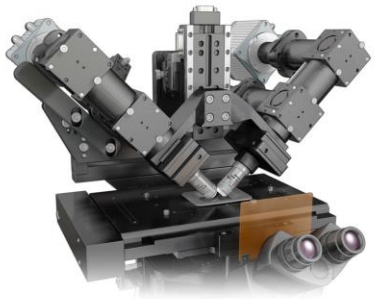
In recent years, as a partner of LENS (Florence, Italy), we have been involved as ML R&D in flagship projects:

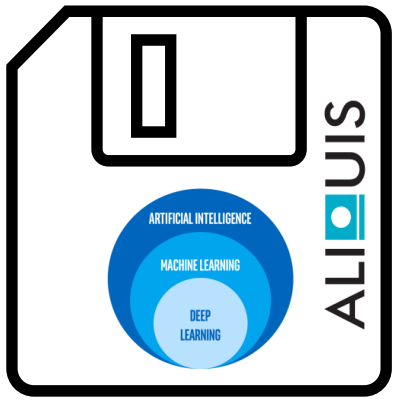
US Brain Initiative

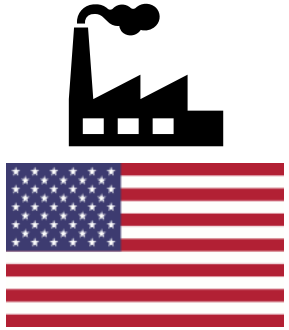
EU Human Brain Project

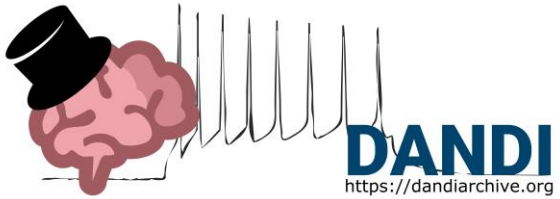
roffilli@gmail.com

The data workflow









EBRAINS

The recipe is simple:

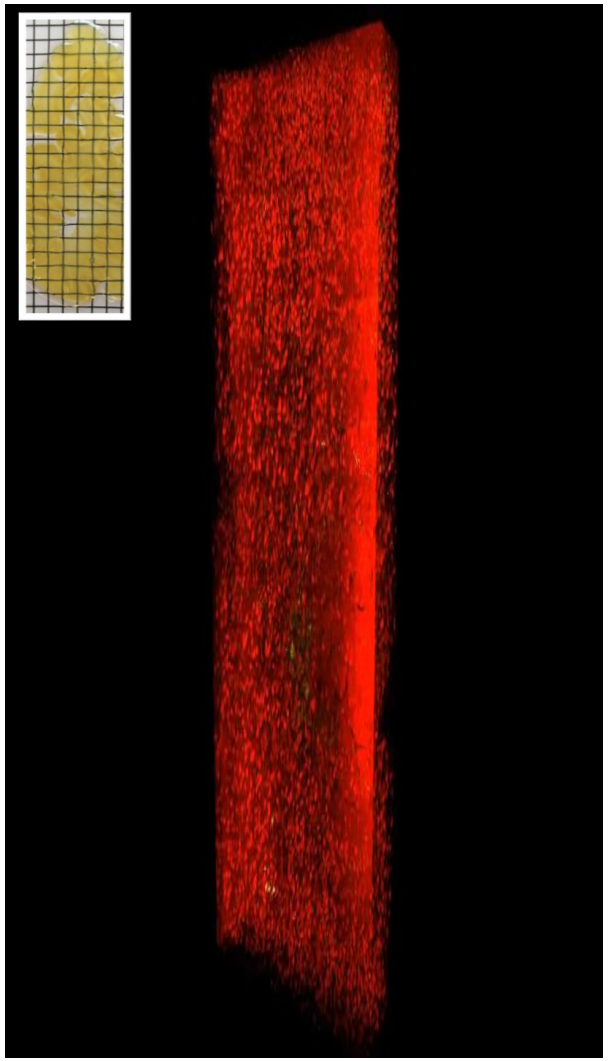
(1) collect a human brain – and ship it overseas, (2) cut the slices and chemically label them for fluorescence
(3) two-photon/SPIM imaging of slices a **1 µm** resolution, and (4) store raw images (plus interpretation) on some repository

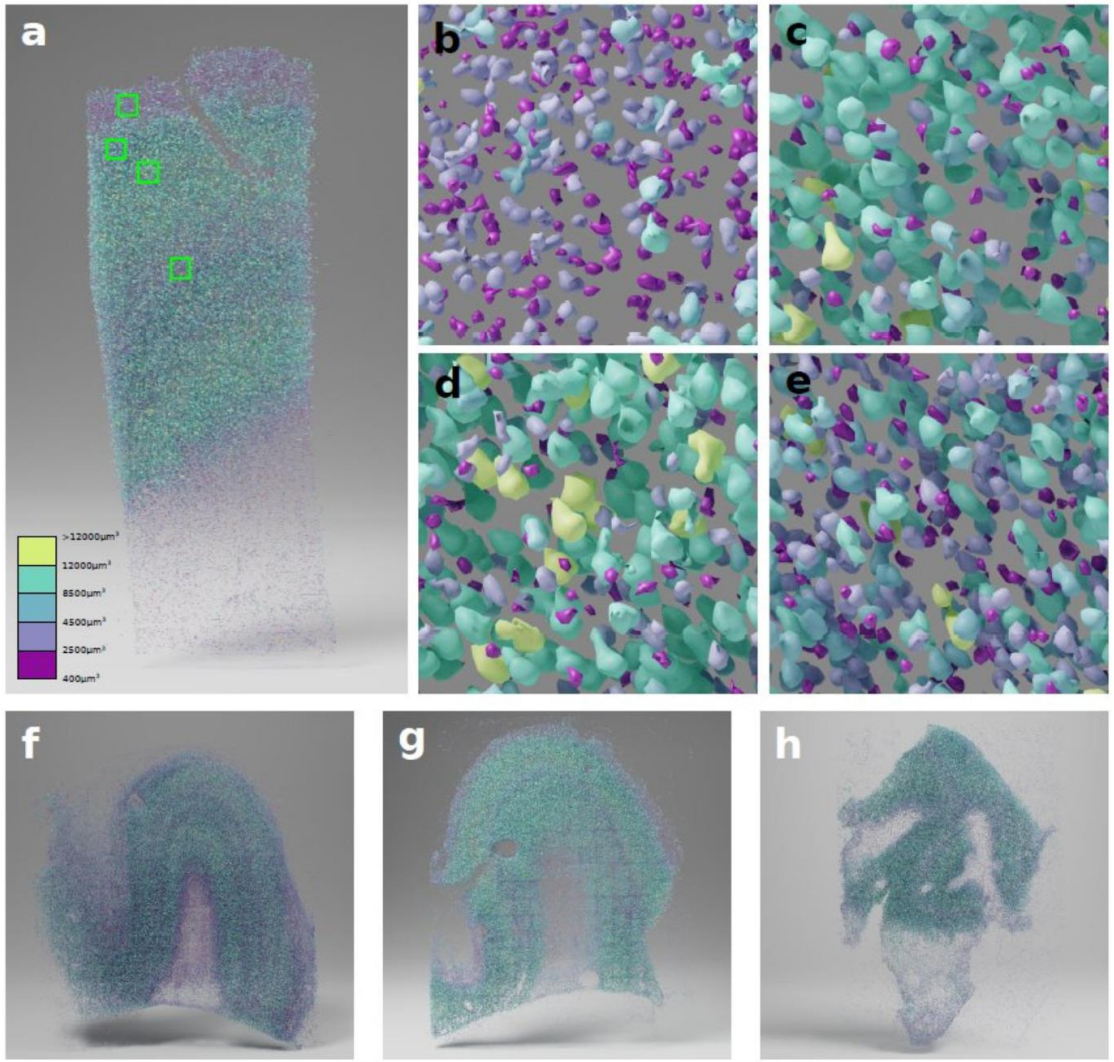
roffilli@gmail.com

Data interpretation via Machine Learning

Accessing data

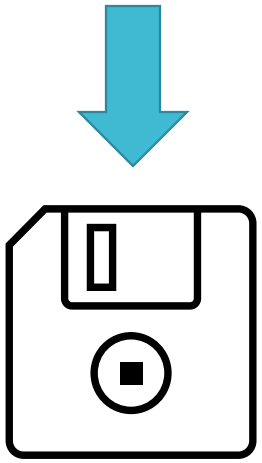
for
Querying
and
Visualizing





Images from:
Costantini, Mazzamuto, *Roffilli*, … , Pavone, "**3D reconstruction and analysis of four human brain cortex samples with two-photon fluorescence microscopy**", EBRAINS (*2020*)
Costantini, Mazzamuto, *Roffilli*, … , Pavone, "**A combined pipeline for quantitative analysis of human brain cytoarchitecture**", bioRxiv (*2020*)

Data workflow



Yes, but a digital copy (1 µm resolution) of one brain is about 10 PetaByte!

Seymour Cray (1925-1996)
Father of supercomputing

16 bit dynamic range
4 channels, 2 views
0.1 mm^3/s
3.200 GB / s

real time processing

RAW		10'000 TB	(1 ÷ 1)
TIFF OME	TIFF OME	3'000 TB	(3 ÷ 1) *lossless*
JP 2000	JPEG 2000	500 TB	(20 ÷ 1) *lossy*
ximage *vectorial embedded metadata*	ALIQUIS	20 TB	(500 ÷ 1) *semantic*

roffilli@gmail.com

www.bioretics.com

A business for a few ?

(and only if powered by AI)

(ok, and with a lot of funds)

one human brain

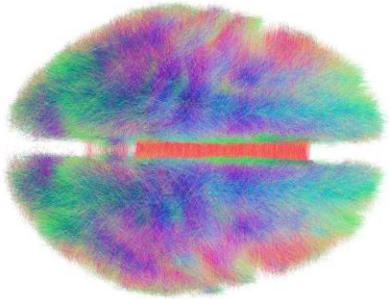
10 PB

one Earth

20 PB

all Google Map data

one human connectome



0,03 PB

"The HCP's neuroimaging approach."
Nature neuroscience (2016)

one human genome

0,00000075 PB

en.wikipedia.org/wiki/Human_genome

bioretics
BEYOND EXPERIENCE

Aliquis® and LAIRA®