How AI is making a difference in Computer Aided Diagnosis

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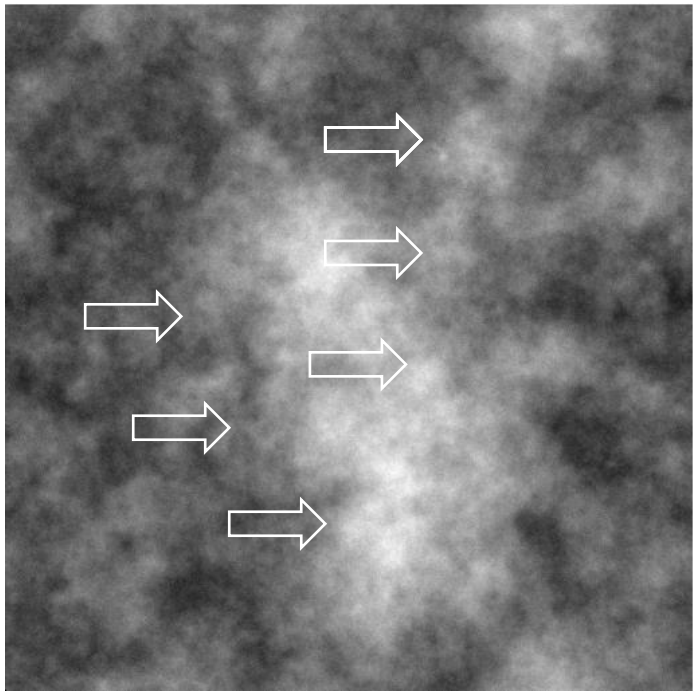
AIMLAC
UKRI CENTRE FOR DOCTORAL TRAINING IN ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND ADVANCED COMPUTING

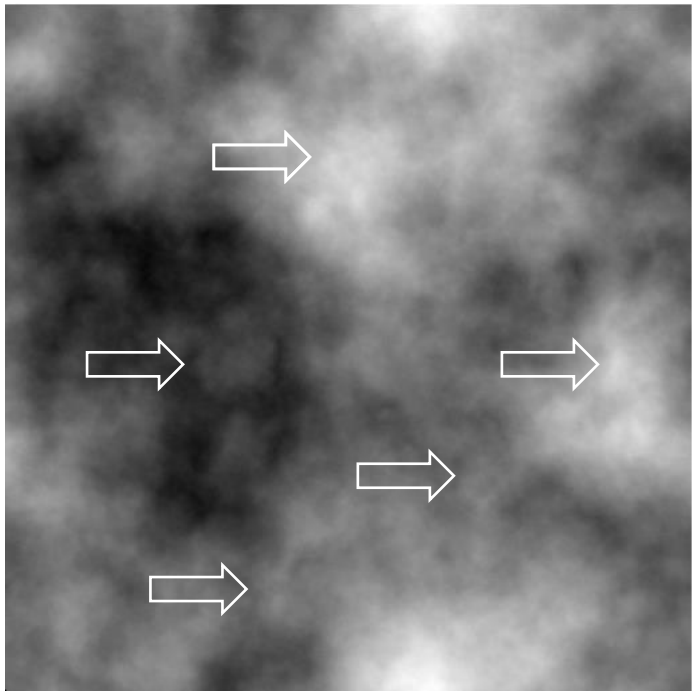
AIBIO UK

Senior Research Leader - Uwch Arweinydd Ymchwil
Cyfadran Ymchwil Iechyd a Gofal Cymru
Health and Care Research Wales Faculty

CAD

How Computer Aided Diagnosis might work





Terms

AI

Computer Vision

Image Processing

Machine Learning

Deep Learning

Medical Image Understanding

Overview

From Lines to Impact

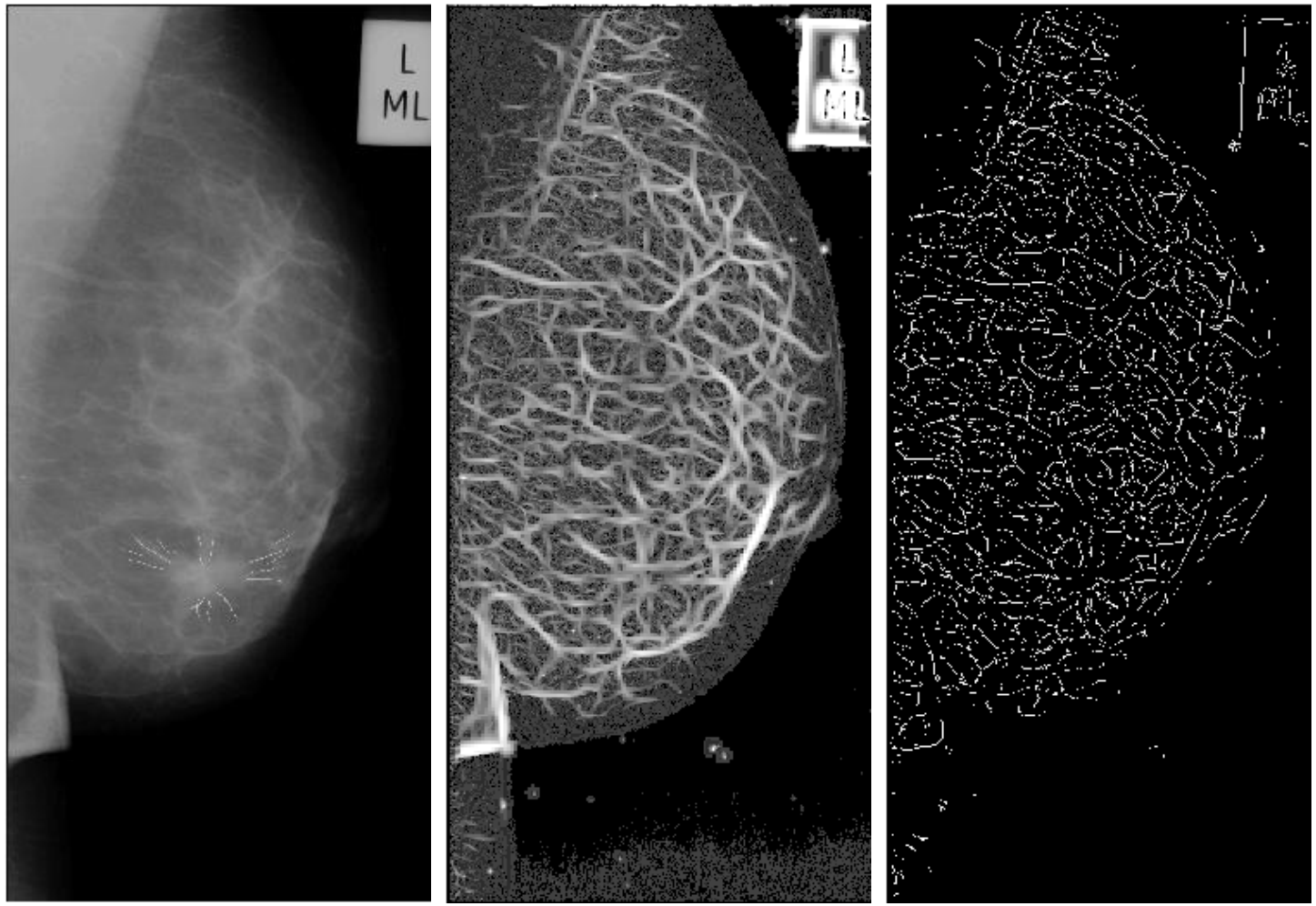
Linking Modalities and Changes over Time

Understanding and Trusting Results

AI Data Readiness and Responsibility

Lines

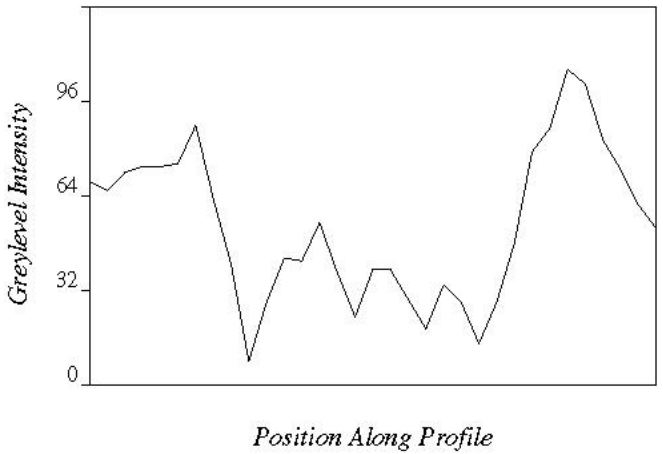
Detection of linear structures in mammograms

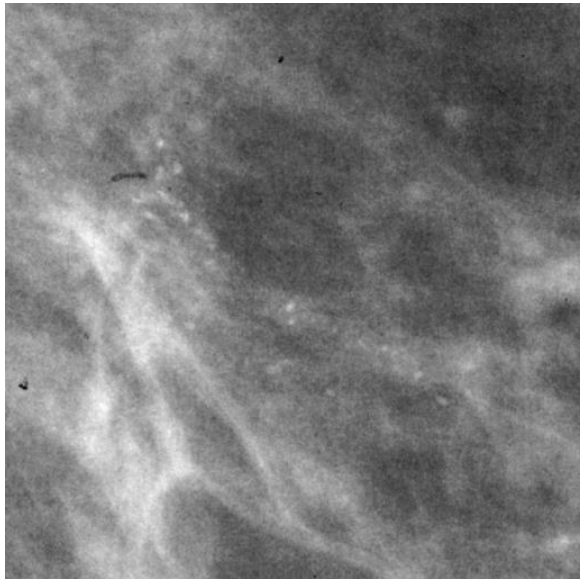


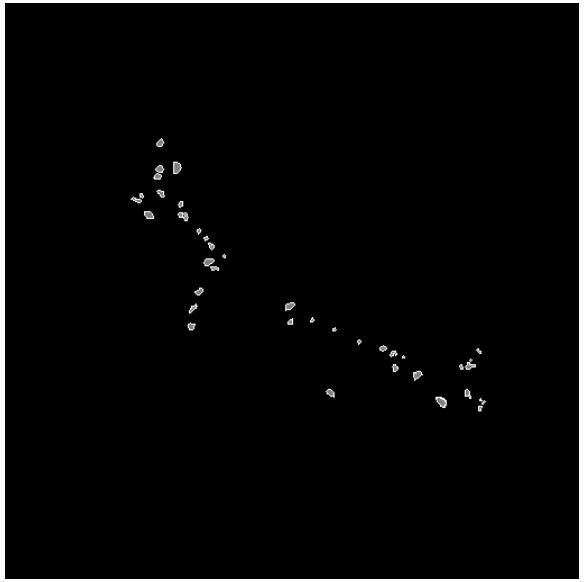
Profiles

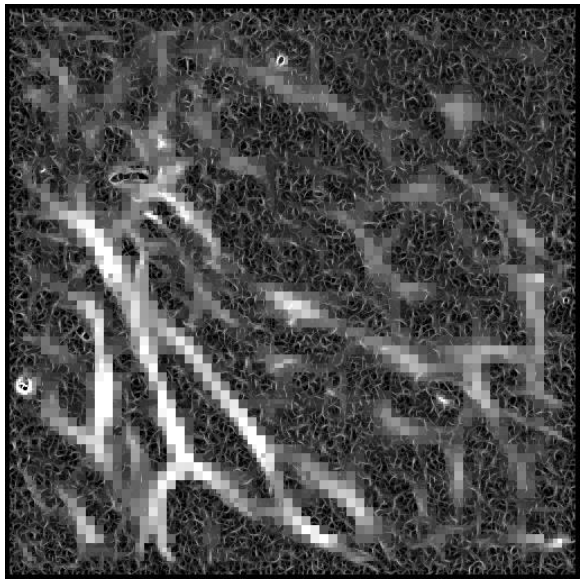
Classification of linear structures in mammograms

We could say if it was a spicule, duct, etc., which helps with the identification of spiculated lesions, DCIS, etc.





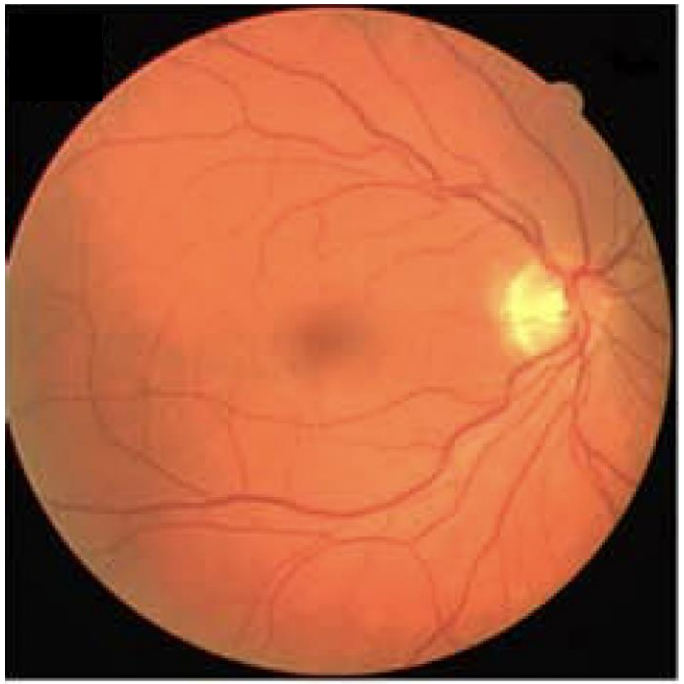






Translation

The line detection methodology has a wide range of application areas, with one been retinal images, with very detailed segmentations covering a range of scales





Impact

Collaboration with a group of clinical end-users
- Peking University Third Hospital
- Royal Liverpool University Hospital

Impact

The incorporation of automated segmentation for the tortuosity of corneal nerve fibres has provided a consistent approach to the assessment of dry eye disease and diabetic neuropathy

At the same time, it has significantly accelerated the processing time of the staging of patients, increasing the volume of patients being treated by 10%

Overview

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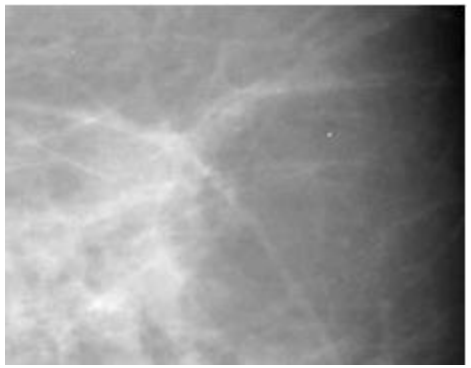
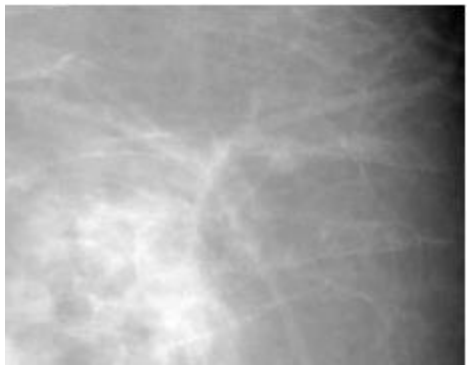
Abnormality Development

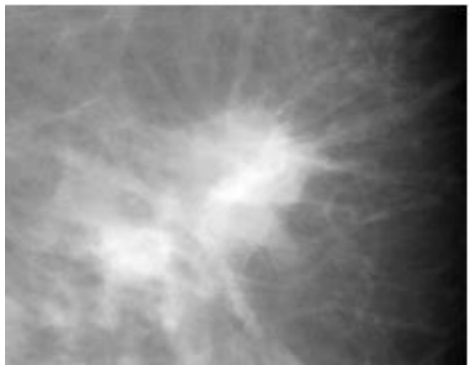
The linear structures could also be used to act as a reference framework for other anatomical structures (e.g. abnormalities)



1992



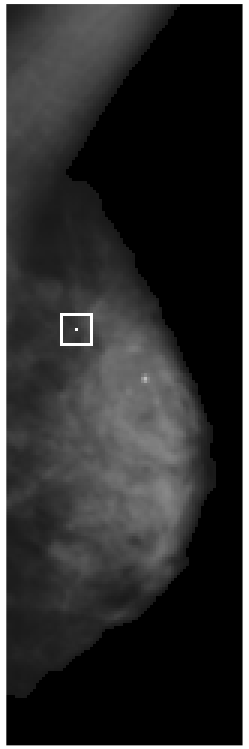
1995



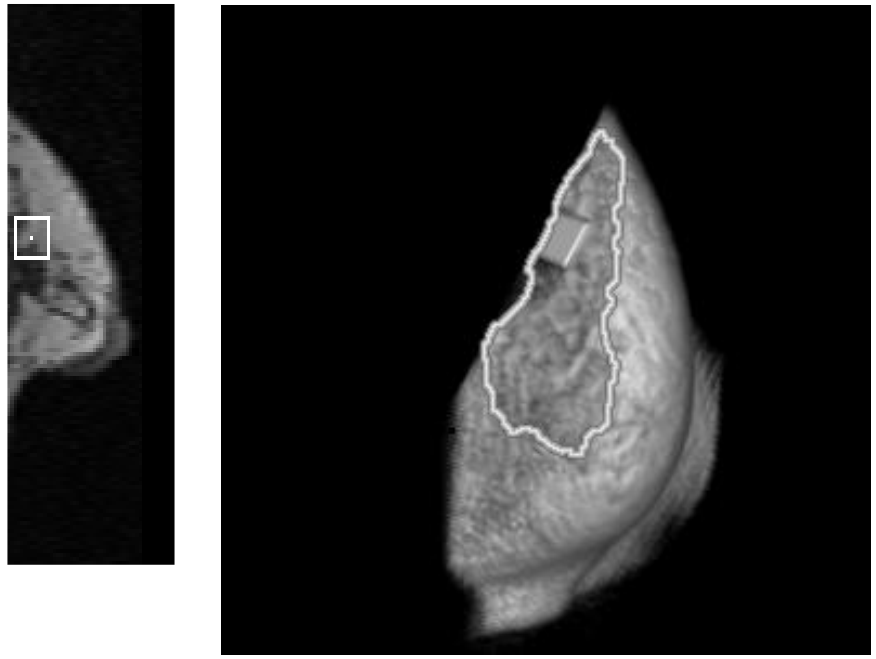
1999

MRI - Mammography

To identify the location of an abnormality which was not visible on MRI.



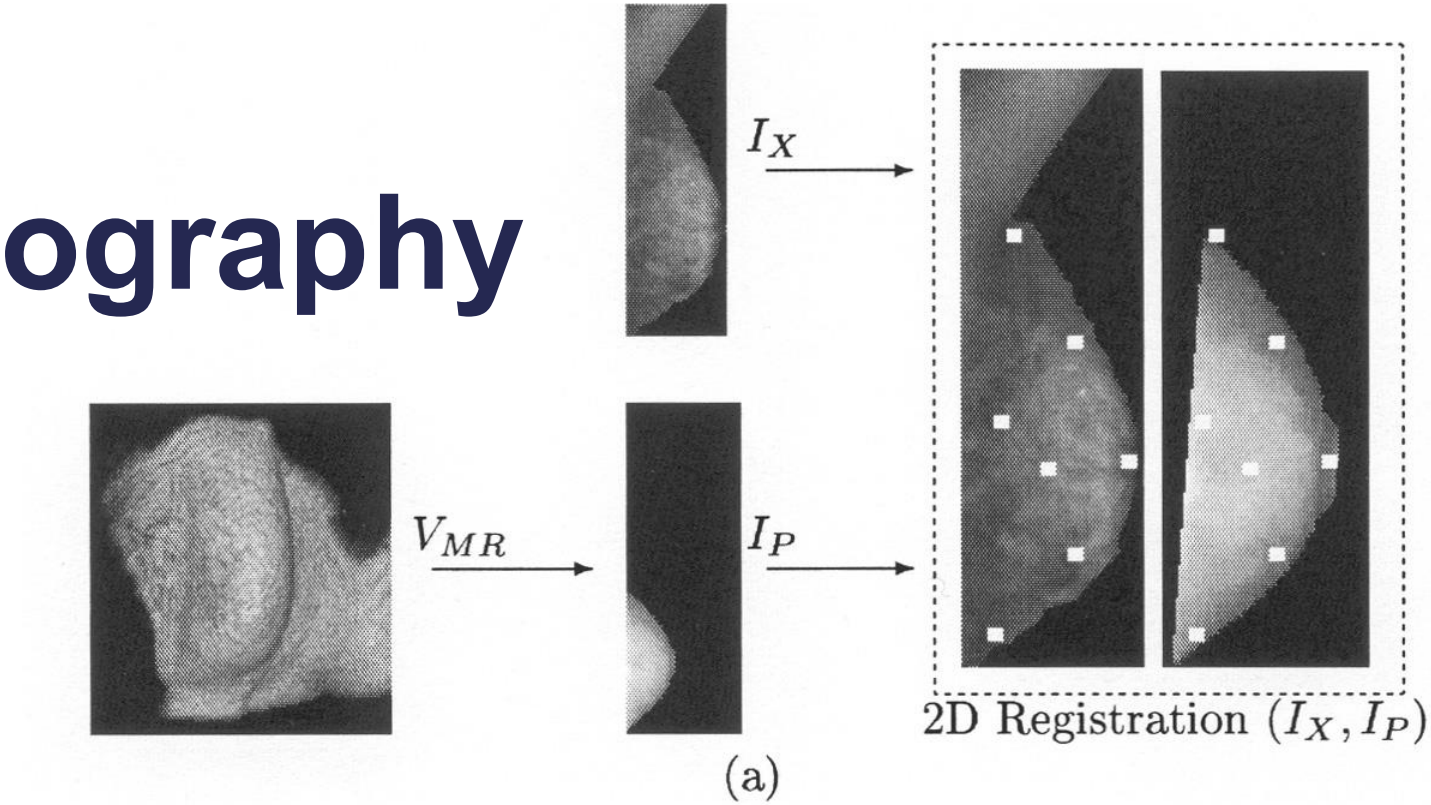
Mammography

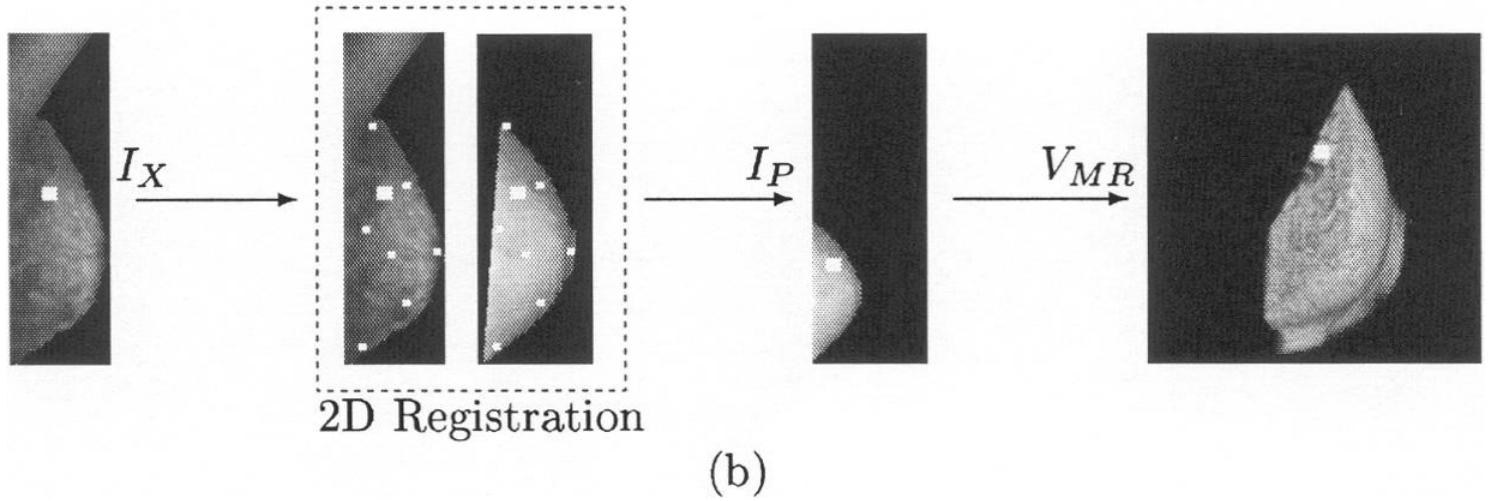


MRI

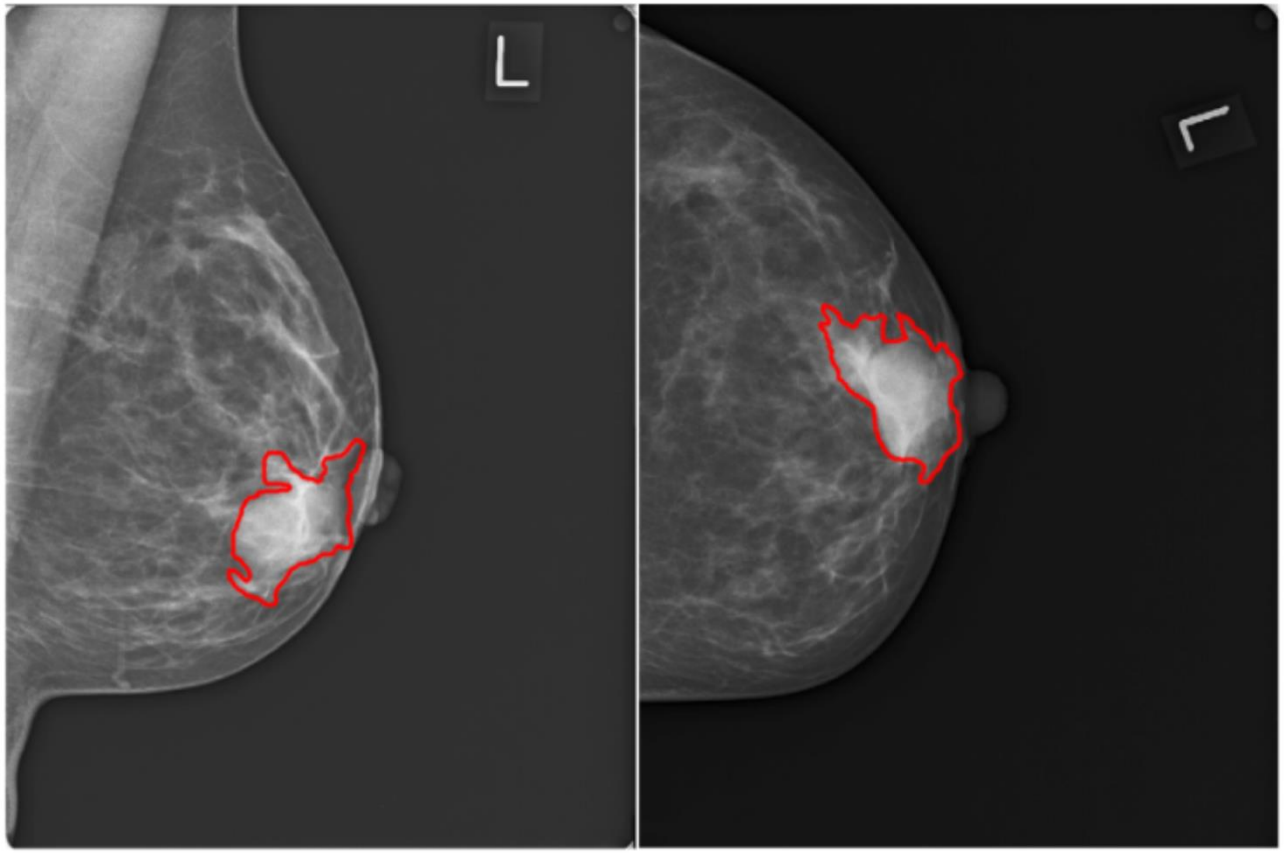
MRI - Mammography

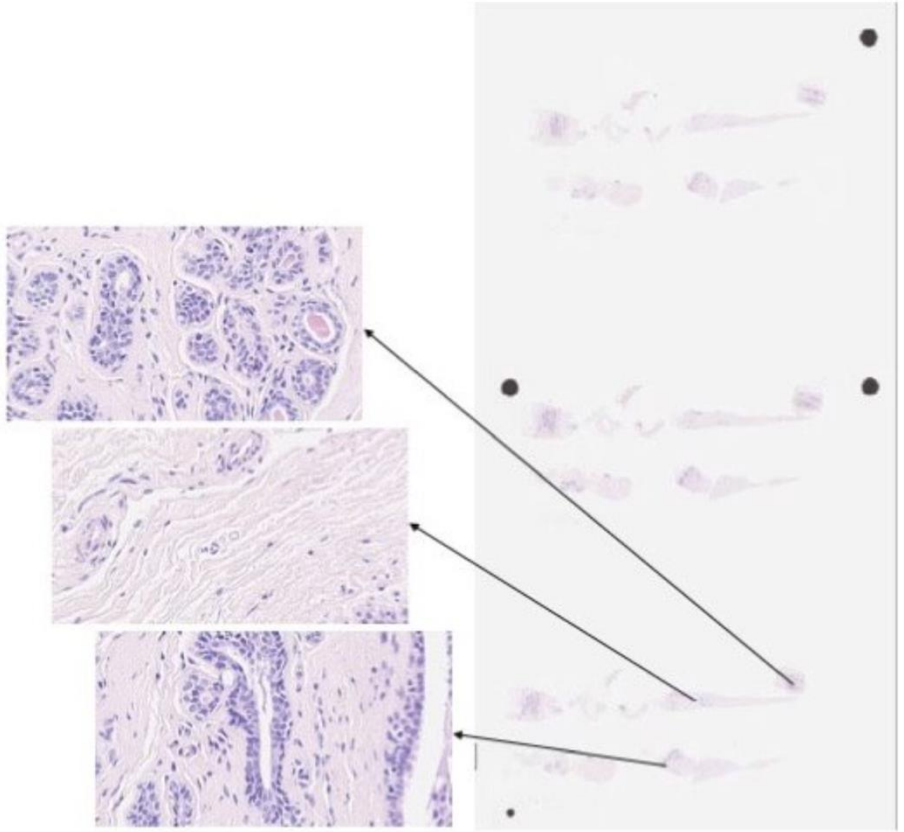
We mapped the abnormality from mammography, where it was visible.





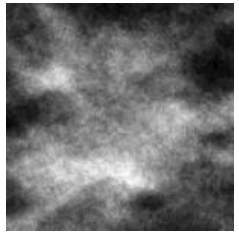
Mammography - Histology

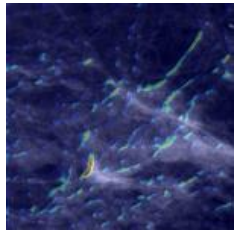


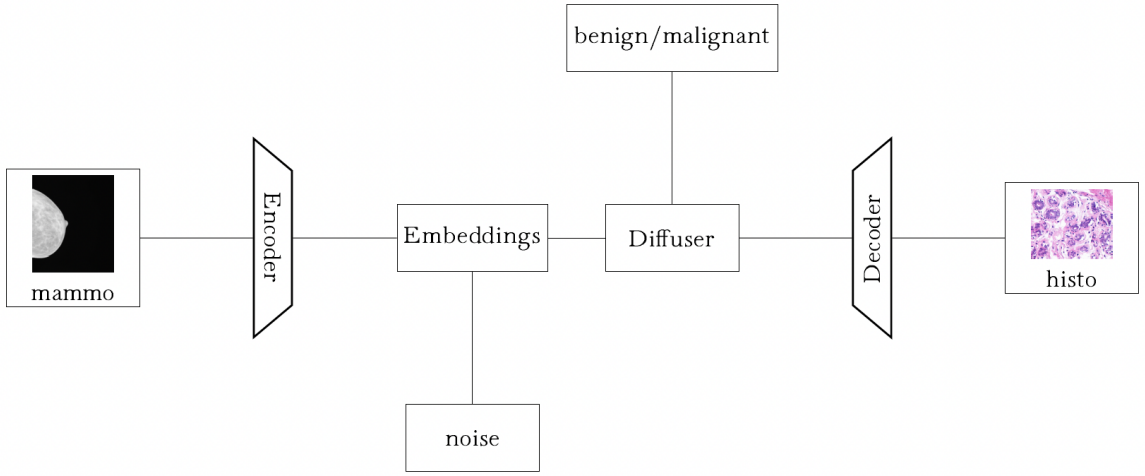


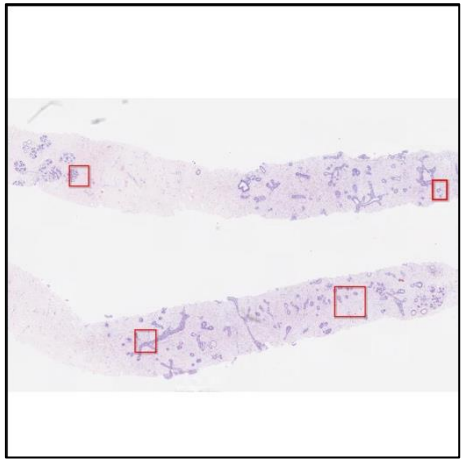
Mammography - Histology

Our most recent work in this area is developing methods to predict histology information from mammographic images….



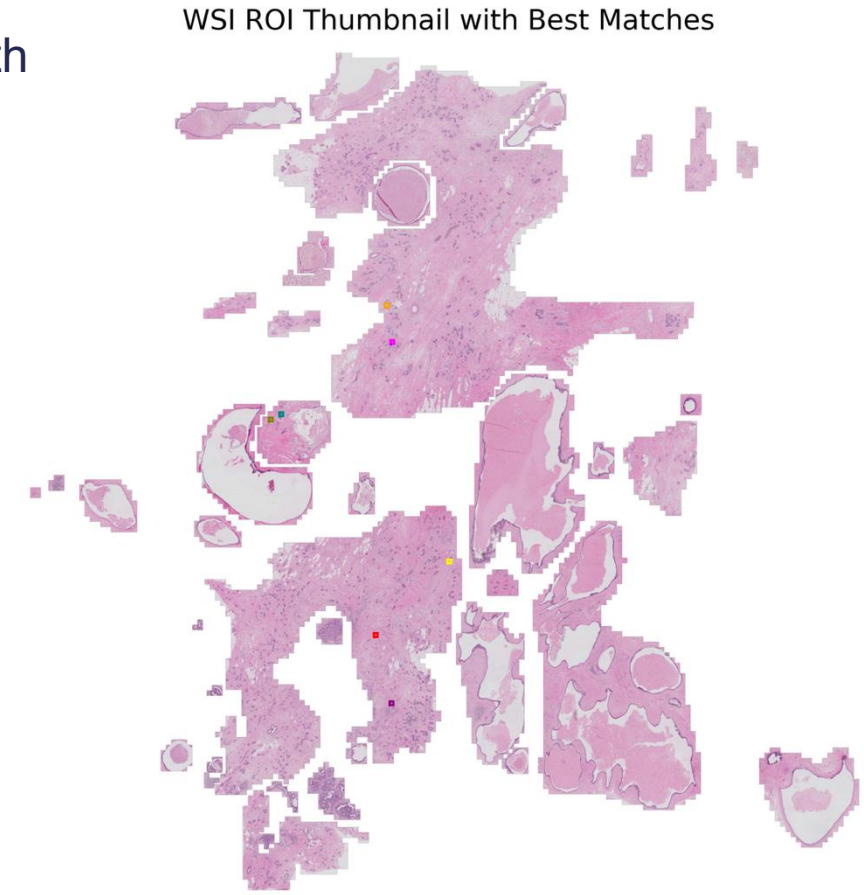


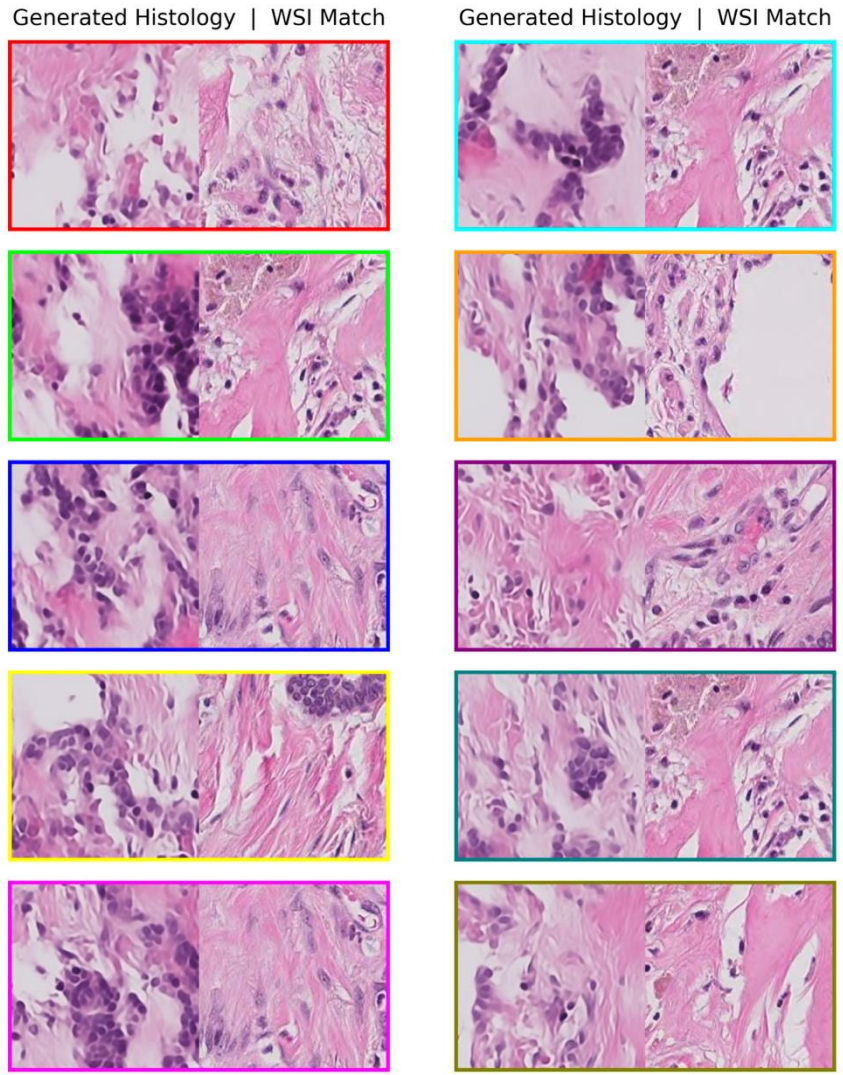




Understanding

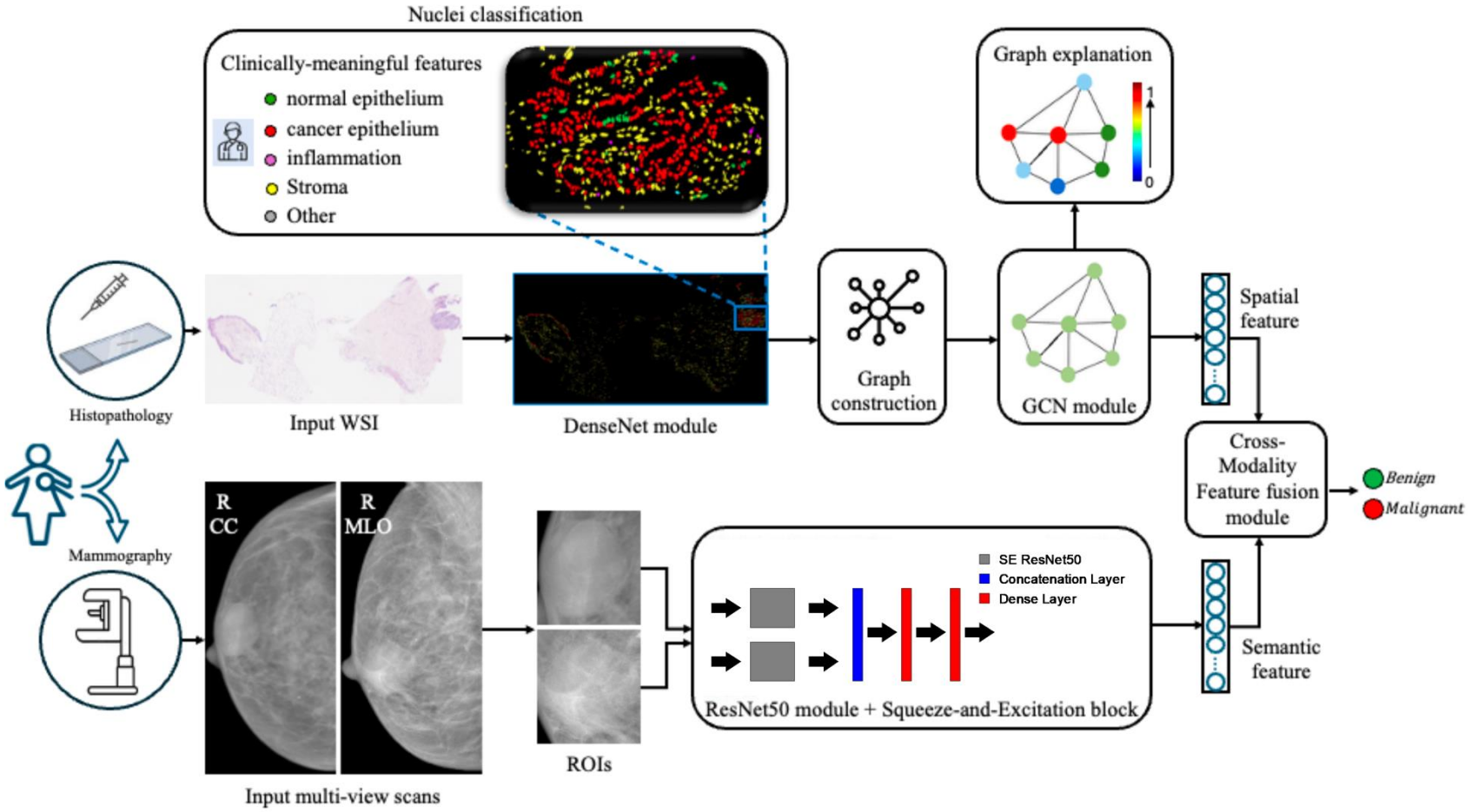
…. and compare them with real patches.





Mammography - Histology

Or to use a combination of modalities and graph networks to enhance predictions



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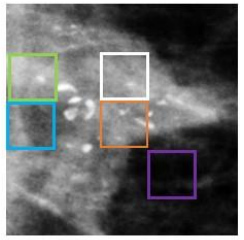
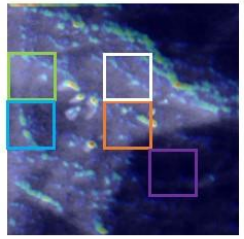
Understanding

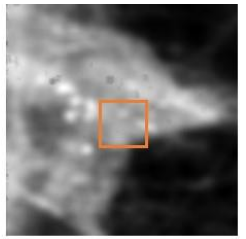
We have investigated links between traditional texture features and deep learned features, which enhances our understanding of what information deep learning models use



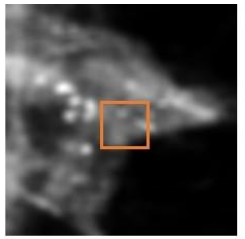
ROI



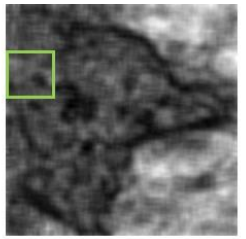
Deep Learned Feature



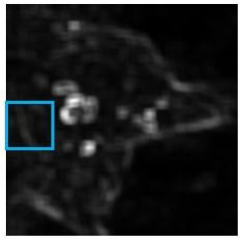
Mean



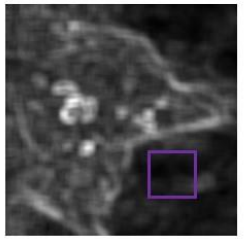
Variance



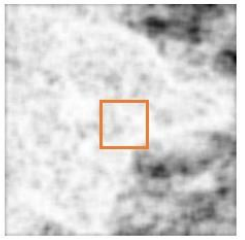
Homogeneity



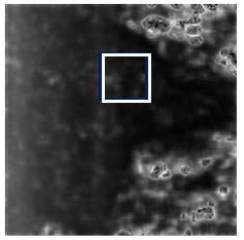
Contrast



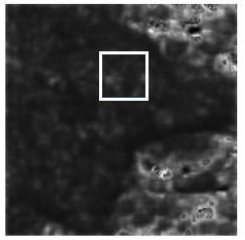
Dissimilarity



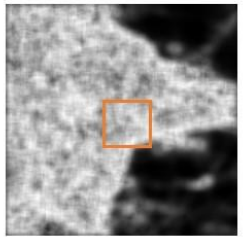
Entropy



Energy



Correlation

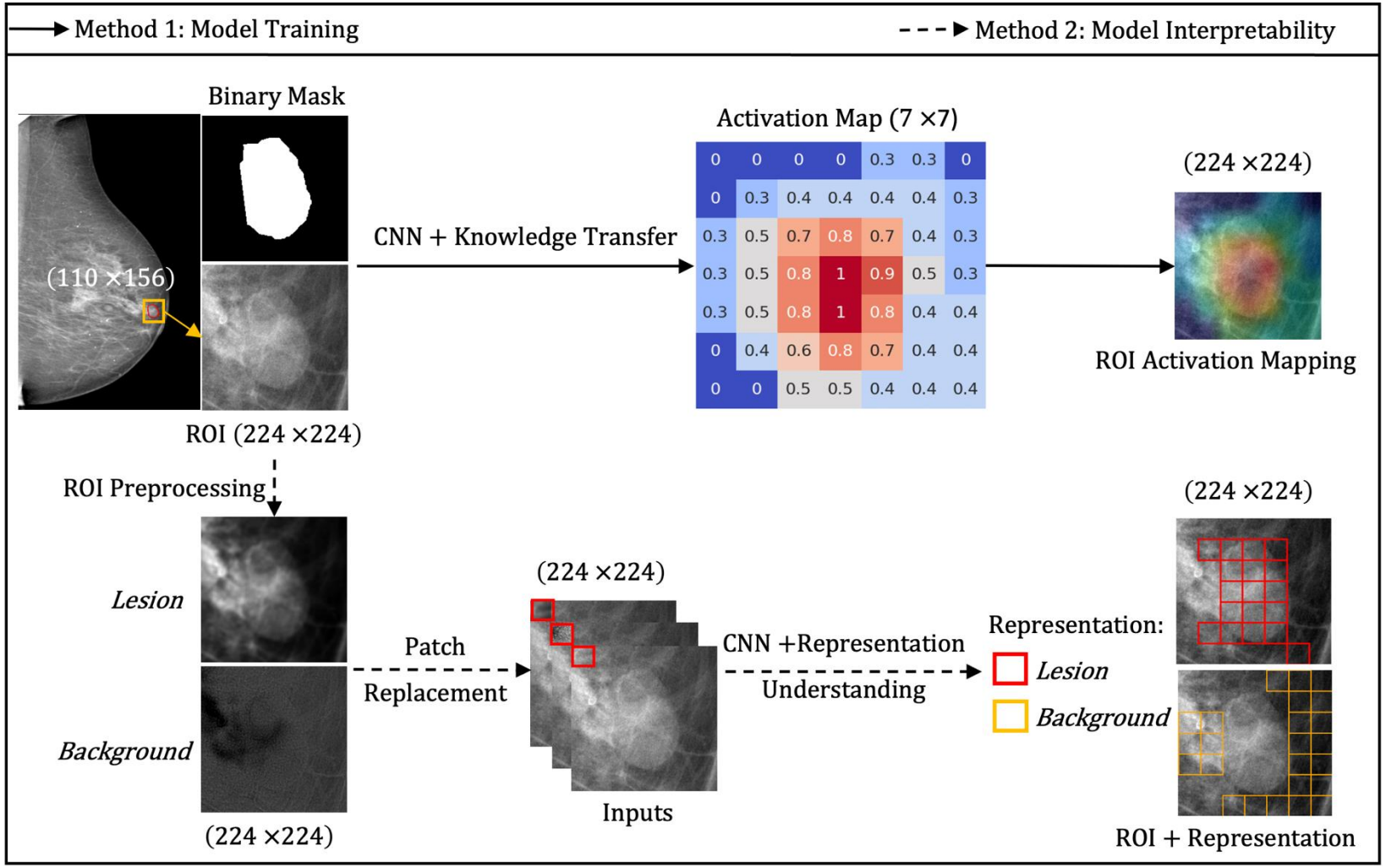


Auto-correlation

Trust

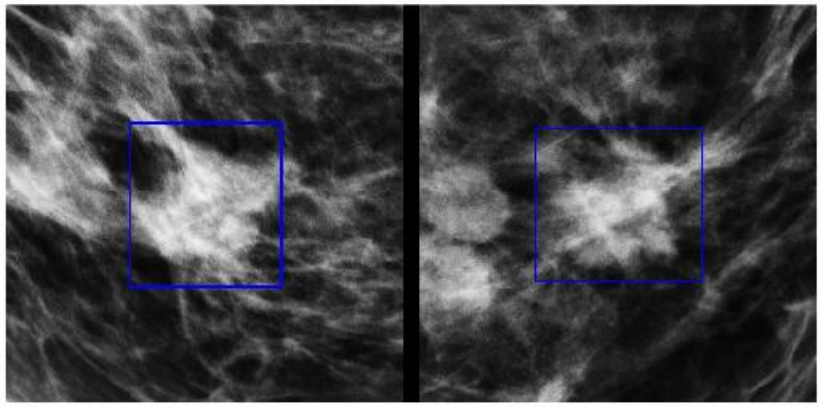
We have been developing methods which show what information has been used in the modelling

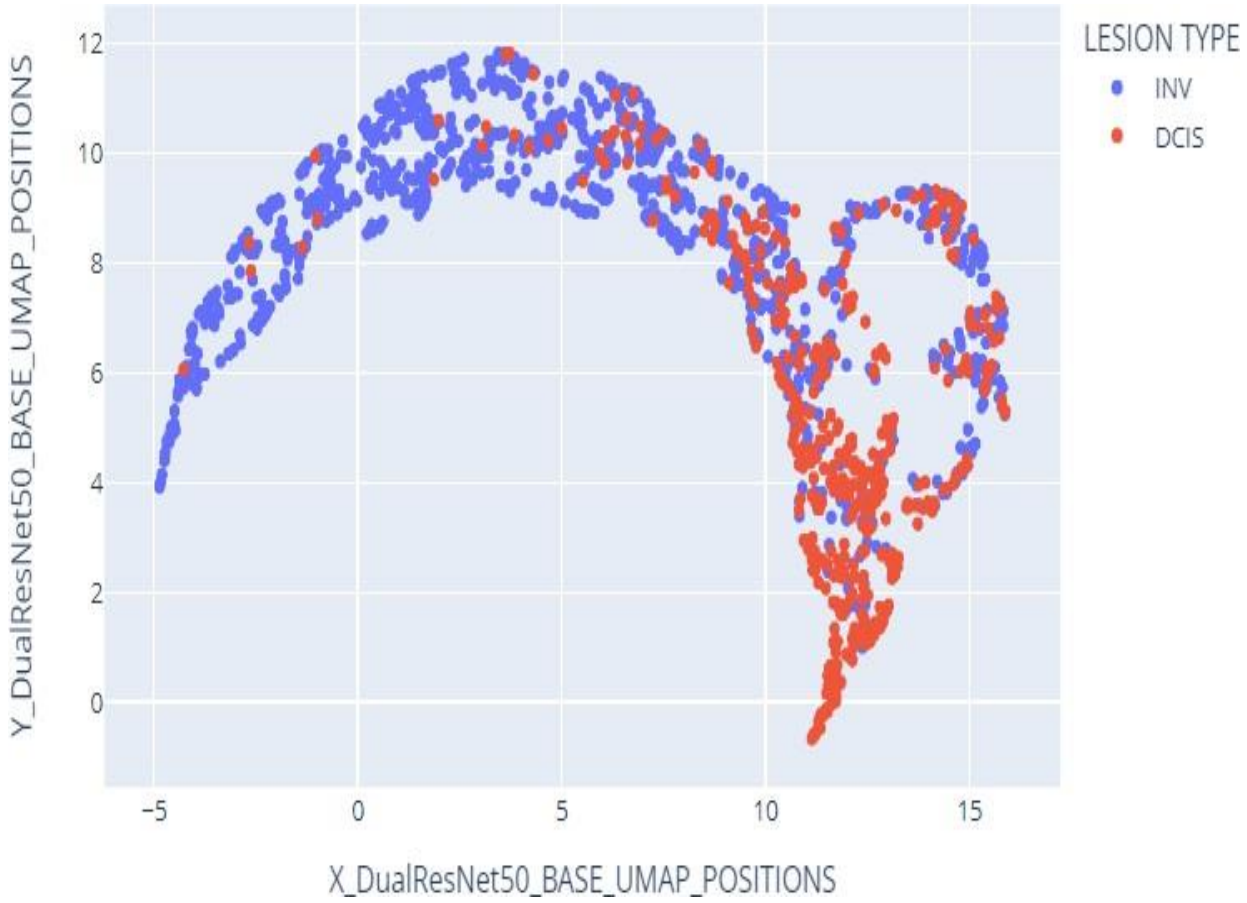
In addition, it provides us with semantic segmentation results and labels



Understanding

We can extract relevant information from traditional and deep learned features, and use this to see how abnormalities might be compared with the aim to improve staging of abnormities





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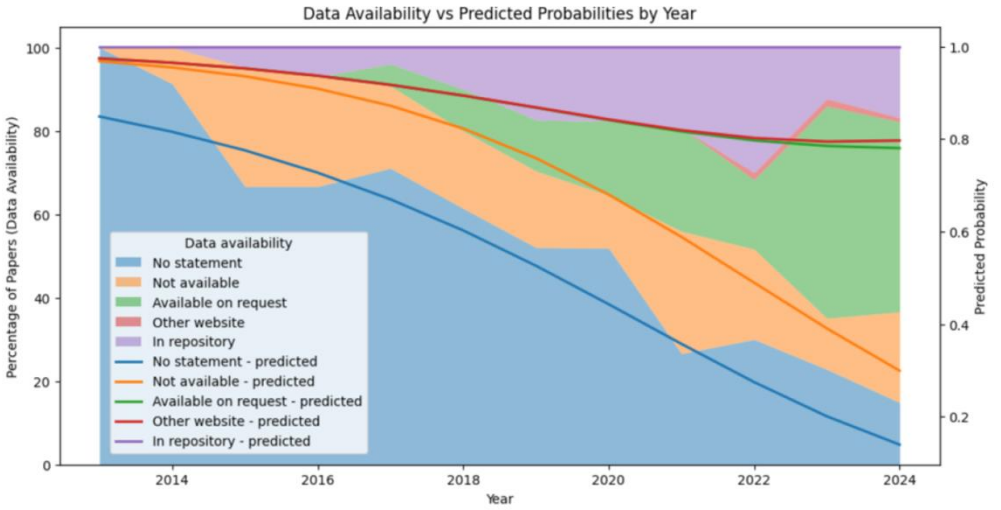
AI FAIR Compliance

We (Charlie Harrison, Tulsi Suchak, Chris Elomaa, Reyer Zwiggelaar, Matt Spick) have been looking at FAIR (Findable, Accessible, Interoperable, Reusable) compliance through a Systematic Evidence Map (SEM) to assess data sharing practices in open-access metabolomics publications.

The results of our pilot study of 1106 publications indicated that while the number of studies including a data availability statement increased from 9% in 2014 to 85% in 2024, 'Available on request' became the most common statement. Just 14% of studies in our pilot made their data available in a repository.

Full study on 5000+ papers ongoing.



AI-ready Bioscience Datasets

We (the AIBIO-UK AIRBDS Working Group) have developed AIRBDS Core, a method of assessing the AI-readiness of datasets, based on existing frameworks. It is designed to be objective, accompanied by clear and explicit criteria; to be applicable to any dataset and application; and to produce a quantitative result based on 25 questions in 4 areas (infrastructure, metadata, content, ethics).

Q ID	Question	Notes	Grade
ABC-01	Can the dataset be accessed in its entirety?	Every entry in the dataset should be accessible via direct download, API, or in a cloud container. This metric is not applicable to datasets behind access controls with an approval process, or in trusted research environments.	Important

Dataset	Repository	Critical	Important	Optional	Score	Grade
Observation.org, Nature data from around the World	GBIF	9/9	9/10	4/6	773	Silver

AI Responsible Use

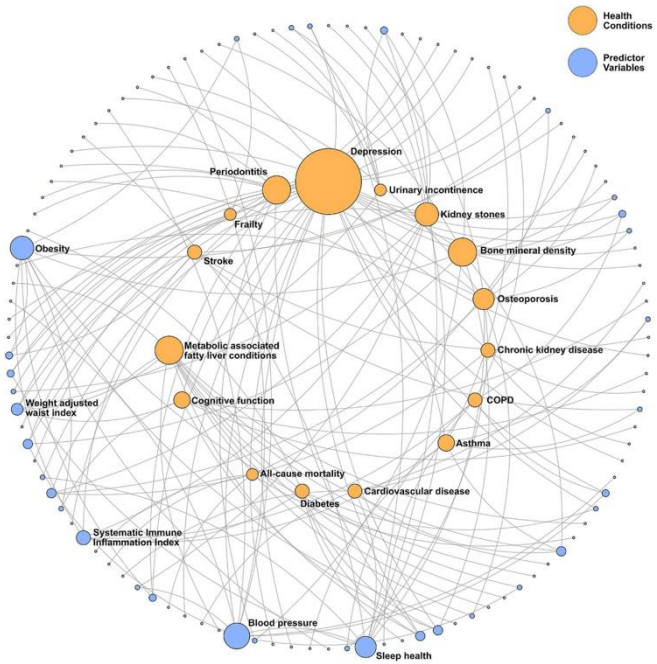
Open-access datasets & generative AI => increase in formulaic papers.

We (Tulsi Suchak, Anietie E. Aliu, Charlie Harrison, Reyer Zwiggelaar, Nophar Geifman, Matt Spick) have explored inappropriate study designs and false discoveries. We found evidence that research failed to take account of multifactorial relationships, that manuscripts did not account for the risks of false discoveries, and that researchers selectively extracted data from NHANES rather than utilizing the full range of data available.

We highlight a set of best practices to address these concerns, aimed at researchers, data controllers, publishers, and peer reviewers, to encourage improved statistical practices and mitigate the risks of paper mills using AI-assisted workflows to introduce low-quality manuscripts to the scientific literature.

Poor science and a burden on the peer review system.





PhDs

Azam Hamidinekoo

Charlie Harrison

Cory Thomas

Guobin Li

Louai Zaiter

Robert Marti

Yitian Zhao

Clinical

Bahar Guner

Caroline Boggis

Caroline Rubin

Elsa Perez

Erika Denton

Josep Pont

Laura Setyo

Funding

BBSRC

EPSRC

HCRW

UKRI

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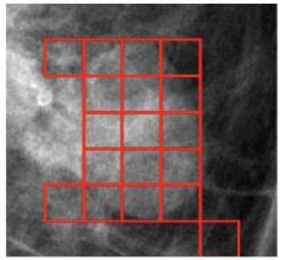

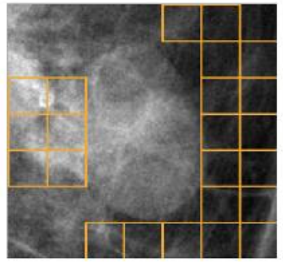

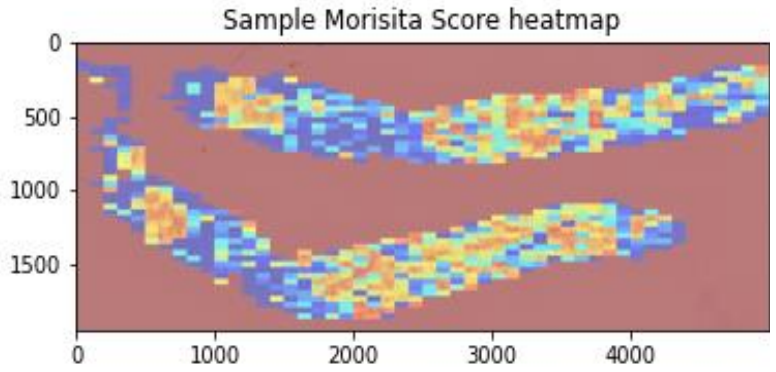

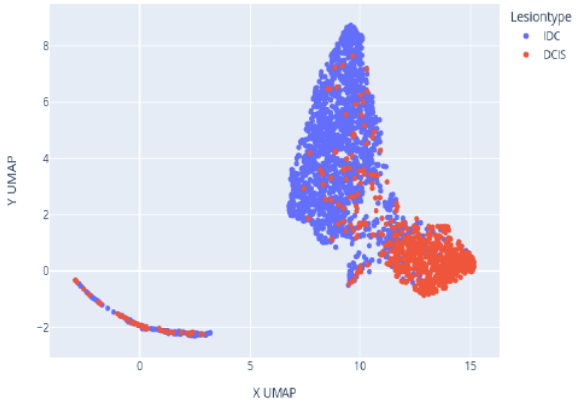

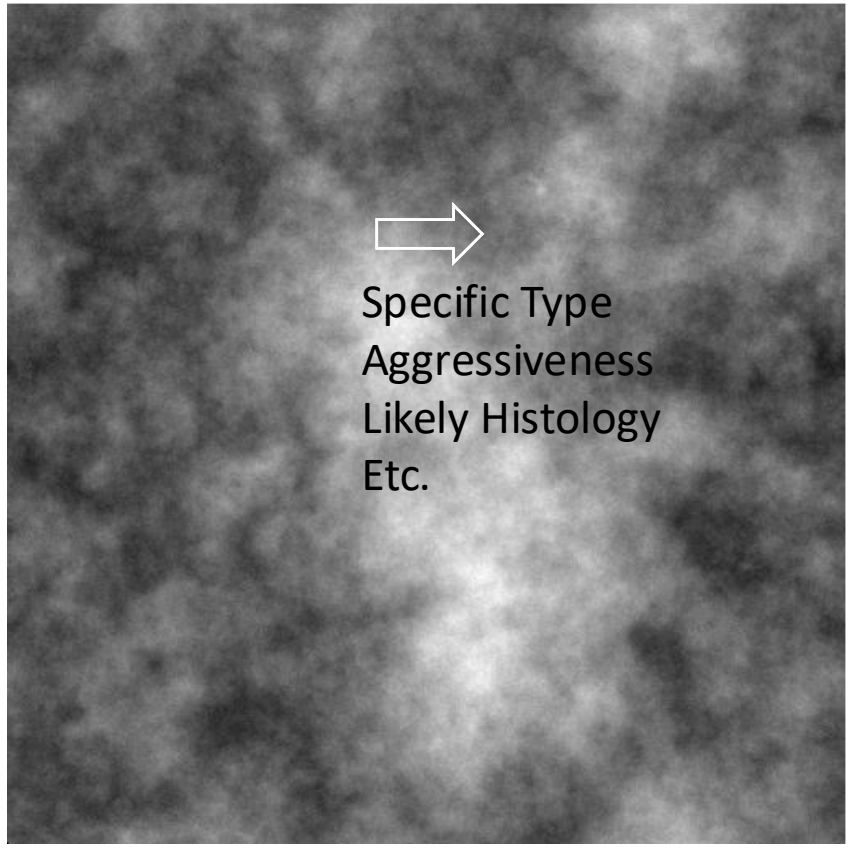

Some Recent/Key References

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- R Zwiggelaar, SM Astley, CRM Boggis, CJ Taylor, Linear structures in mammographic images: detection and classification, IEEE Transactions on Medical Imaging 23 (9), 1077-1086, 2004.