Image based breast and tumour characterization
WP3 - ANALYZE

John Winder

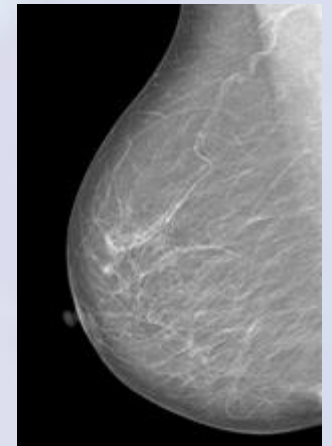Hui Wang, Philip Morrow, Bryan Scotney, Ulster

Gregory Maclair, Ivan Macia, Vicomtech

Purpose

- To generate novel and clinically relevant image based biomarkers for breast cancer

- Biomarkers used to indicate the presence and potentially the severity of disease

- Measurable indicator; volume, density, calcification, pharmacokinetics and physiology

Task 3.1 Segmentation DM & DBT

- To separate breast tissues (glandular, fat, skin, chest wall, image background)

- Breast density linked strongly to risk of breast cancer

- Develop novel automated methods

- Validated against expert segmented images

- Initial testing using Breast Cancer Data Repository
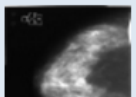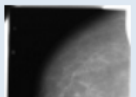
BCDR – digital mammo cases

Task 3.2 characterisation of breast

- BIRADS classification
- Regional breast density measure
- Local breast density measure?
- Quantify calcification?
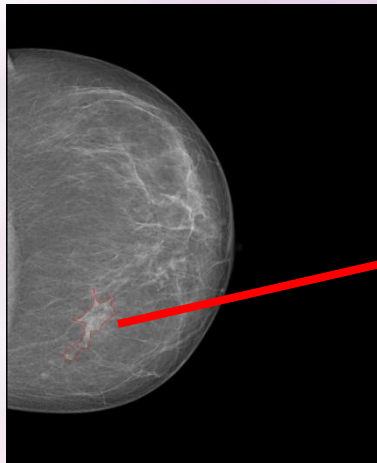
4084 x 3328
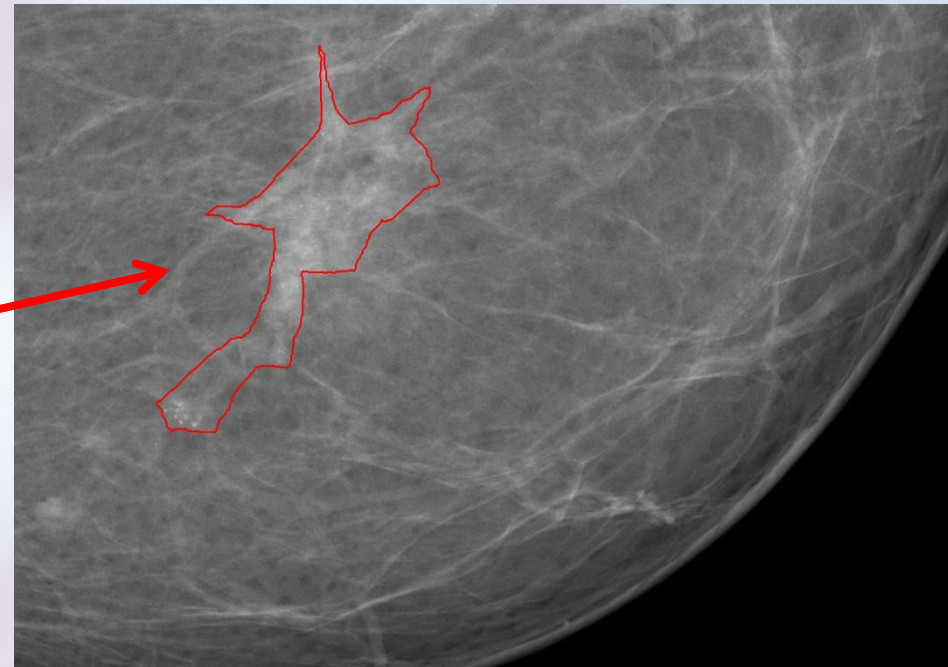
Breast characterisation
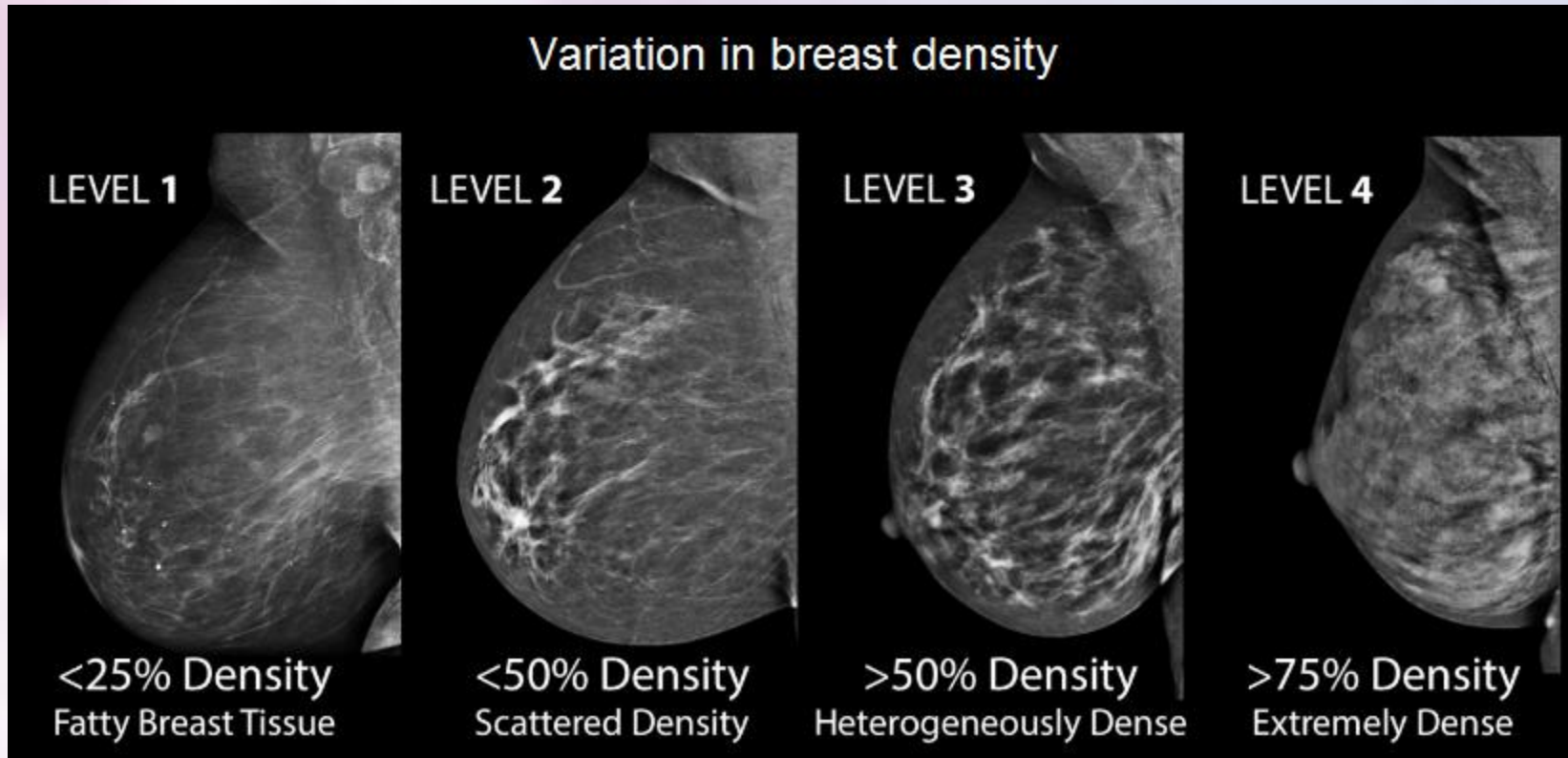
Quantify breast tissue components, including morphology and tissue content

Task 3.3 Segmentation MRI

- Automated segmentation of breast tissues (chest wall, glandular, fat, skin envelope, background)

- Automated image processing

- Automated segmentation and characterisation

- No existing image databases

Magnetic Resonance Imaging

- High soft tissue contrast

- Variable access around Europe

- High image quality

- Anatomy and Physiology

Multi-parametric MRI

- ## What is MP MRI:
  - T1-Weighted Imaging (T1WI)
  - T2-Weighted Imaging (T2WI)
  - Diffusion-Weighted Imaging (DWI)
  - Dynamic Contrast-Enhanced Imaging (DCE)
  - MR Spectroscopic Imaging (MRSI)
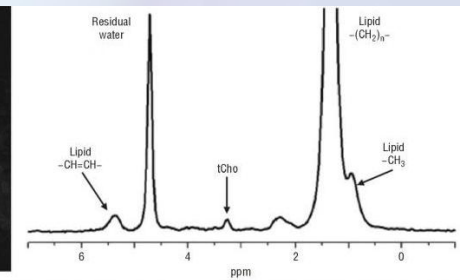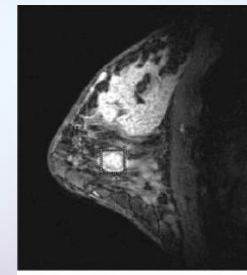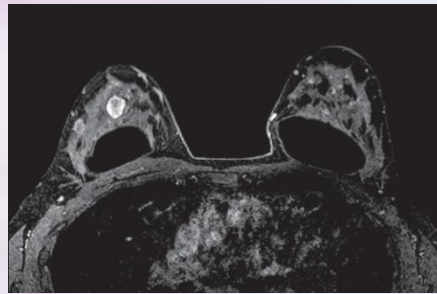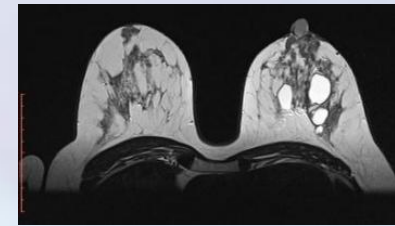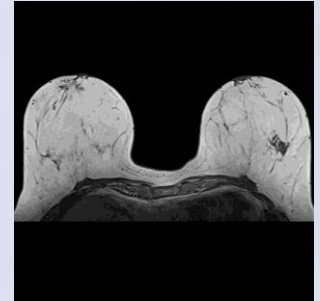
Why use MP-MRI?

- T1 and T2WI give anatomical and structural information both of breast and tumour tissues.
- DWI, DCE and MRS Imaging give functional information:
  - DWI: Apparent Diffusion Coefficient (ADC) value gives information about the benign or malignant character of a lesion
  - DCE: PK model values give information about tumour vascularisation
  - MRSI: Tumour metabolism characterisation (e.g. choline level)

Task 3.4 characterisation of the breast

- Relative amount of fibroglandular tissue and fat tissue

- Quantitative measures to compute tissue breast density

- Compare with BI-RADS and DM/DBT measures

- Morphological characterisation of breast

Specialist MRI – automated segmentation
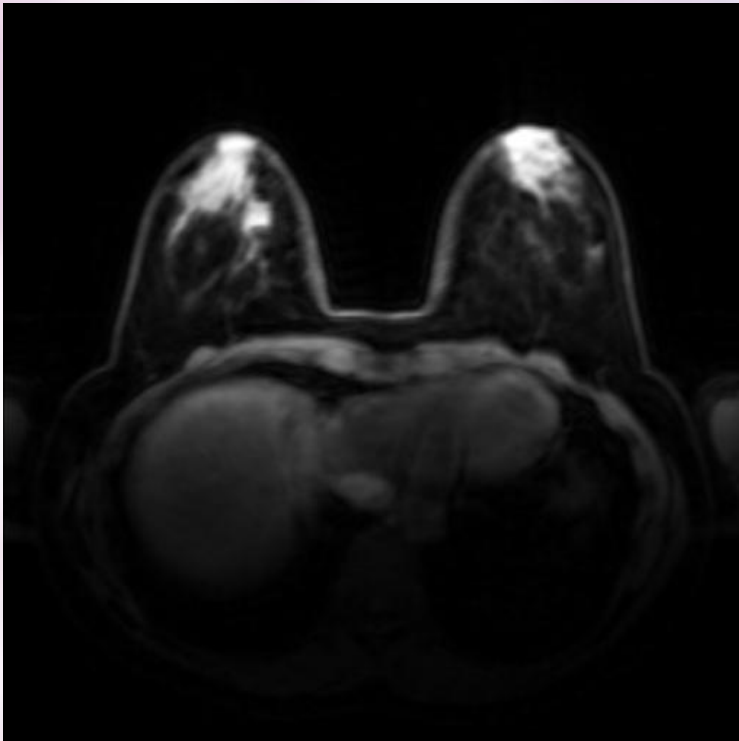
Water signal only
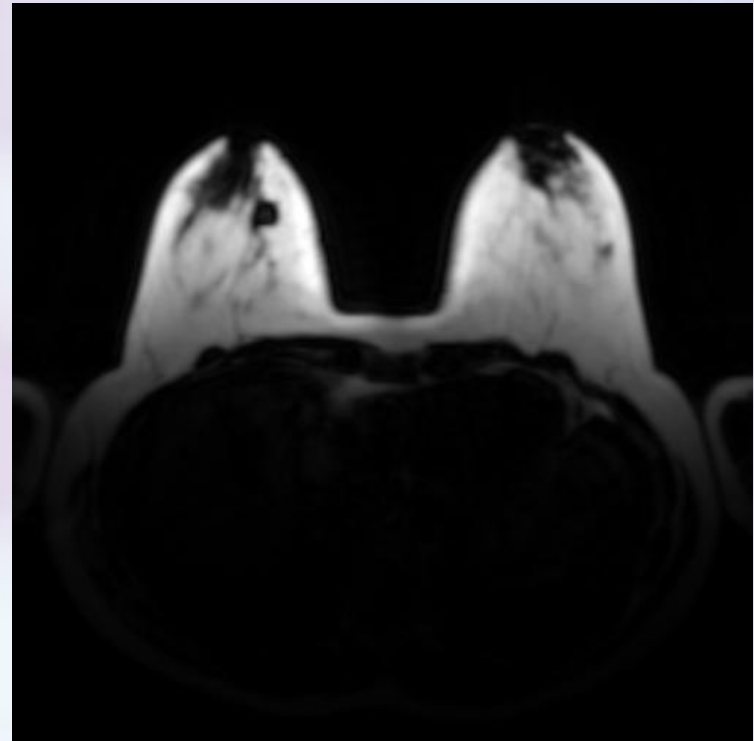
Fat signal only

Task 3.5 characterisation of tumour

- Anatomy and physiology from MRI

- Tumour morphology, size, volume, spiculation
  MRI & DBT

- Tumour physiology from contrast pharmacokinetics
  Novel approaches needed here: rate of wash in/wash out,
  time to peak, time to plateau …

3D morphology

Slice 14   18   22   26   30

L-cc FFDM   L-cc DBT ST-mode   L-mlo- DBT HR-mode
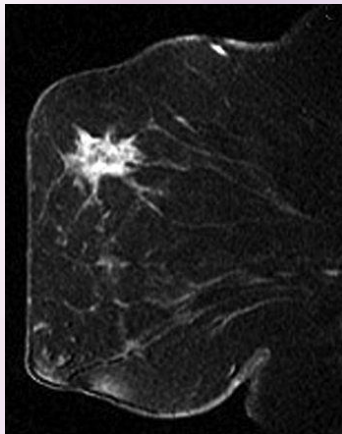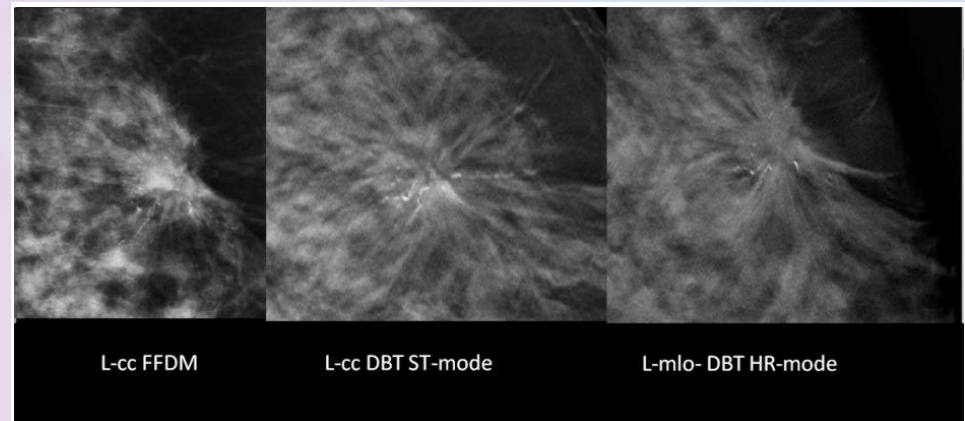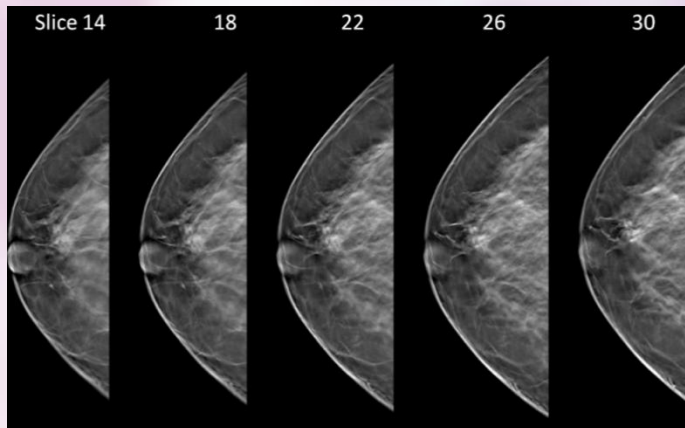
- 3D visualisation, degree of circularity, spiculation

Task 3.6 Multi-modality fusion

- Fusion of 3D data sets

- 3D available from DBT and MRI

- Breast compression?

- Can we compress the MRI breast to match DBT? (UOH, UOU, VIC)

- Enhance multi-parametric analysis

Mammography - 2D and 3D

- Positioning of woman very different for each modality – breast morphology altered greatly

- Require non-linear registration

Links to WPs

Multi-modality imaging definition

Cloud implementation for web-based imaging tools

WP3 ANALYSE
- DM and DBT breast characterisation
- MRI breast tissue characterisation
- MRI tumour tissue characterisation

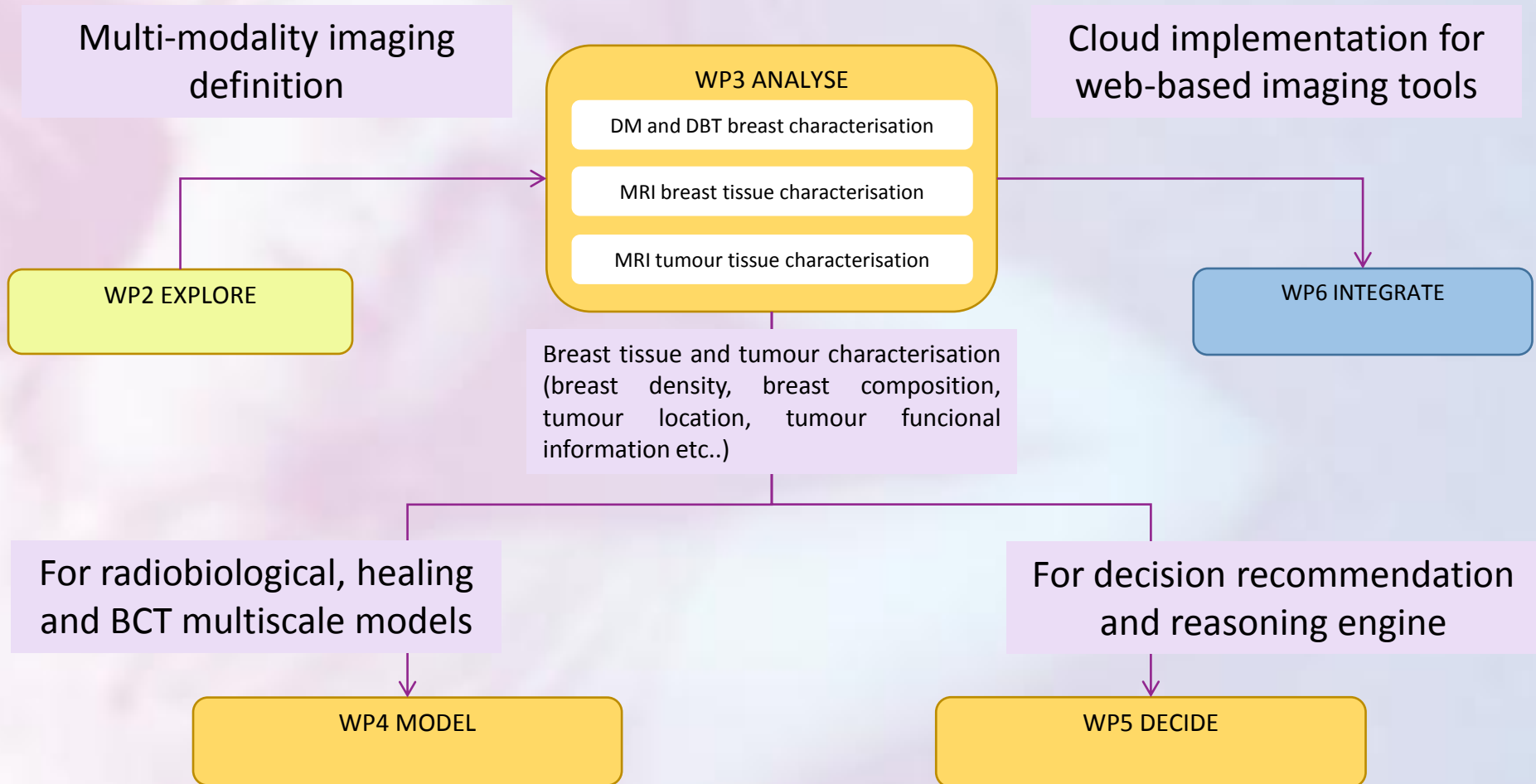**WP2 EXPLORE**

WP6 INTEGRATE

Breast tissue and tumour characterisation (breast density, breast composition, tumour location, tumour funcional information etc..)

For radiobiological, healing and BCT multiscale models

For decision recommendation and reasoning engine

WP4 MODEL

WP5 DECIDE

Strengths/weaknesses

- Image data available
- Strong computer science in Vicomtech and Ulster
- Clear parameters

- Novel approaches (lots already done)
- Clinically relevant
- How do we test?

Summary

- Novel approaches

- Multiparametric approach

- Objective outcomes