

John Winder Hui Wang, Philip Morrow, Bryan Scotney, Ulster Gregory Maclair, Ivan Macia, Vicomtech



Purpose

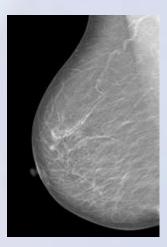
- To generate novel and clinically relevant image based biomarkers for breast cancer
- Biomarkers used to indicate the presence and potentially the severity of disease
- Measurable indicator; volume, density, calcification, pharmacokinetics and physiology

VICONTECH Carivis Carivis Bilbomàtica D CERESA CARACTER C 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

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- Validated against expert segmented images
- Initial testing using Breast Cancer **Data Repository**





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Film Digital						
→ Select the characteristics desired for the search. Blank form show all the patients in the repository.						
Gender 🕑	Age(Value) Ag	e(Interval) 🕜	Breast Density	, 😢	Breast Location 🔞	
🔲 Female 📃 Male			🗆 n/a	< 25%	🗆 Left 🔲 Right	
Segmentations 🕖	Value			% 🔲 51% to 75%	QSI 📃 QSI	QSE
With Segmentations?			> 75%		QII	QIE
Patient 🕜					Axillary Retroareolar	Central
					_	
Mammography 🚱	Biopsy Result 🕜		Definitive Diag		Classification 😯	
🗆 Normal 🔲 Anomaly	No		No No	Benign	 Unnasigned Birads 0 Birads 1 Birads 2 	
O Nodule	Benign Suspect		C.I.S.	Invasive C. Others	 Birads 1 Birads 2 Birads 3 Birads 4A 	
Microcalcification	Suspect Insufficient / Unrepresen	tativo	Undetermin		Birads 4B Birads 4C	
Calcification	Malignant	lative	O ondecennin	eu	Birads 5 Birads 6	
Axillary Adenopathy Architectural Distortion	<u> </u>					
Stroma Distortion						
Search Reset search						
Patient 1	Patient 2	Patient 3		Patient 4	Patient 5	
Age 71	Age 53	Age 64	- 48	Age 62	Age 65	· 1900
Female	Female	Female	10053	Female	Female	
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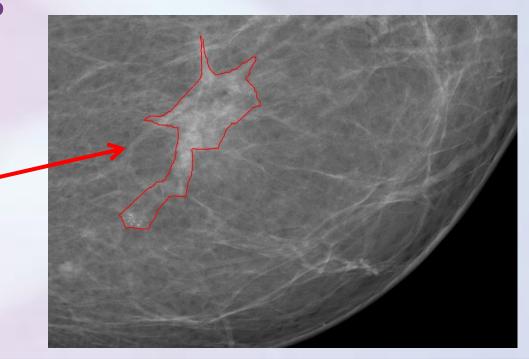


Task 3.2 characterisation of breast

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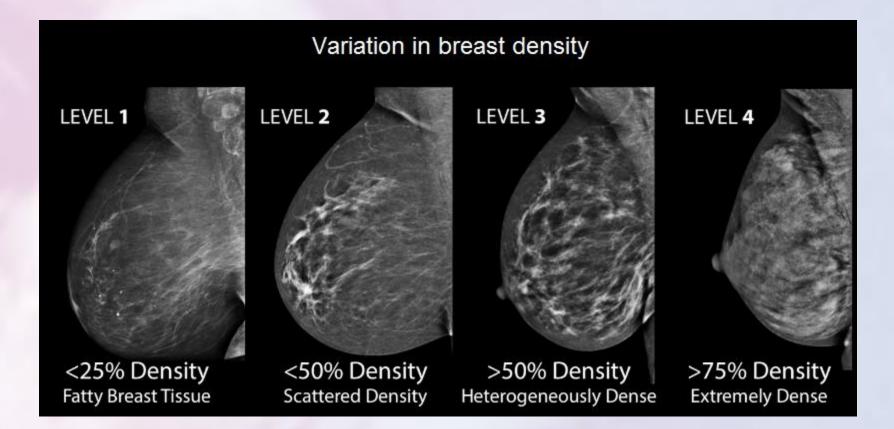
- BIRADS classification
- Regional breast density measure
- Local breast density measure?
- Quantify calcification?

4084 x 3328



Breast characterisation

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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

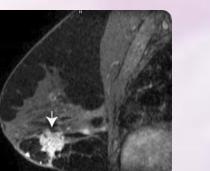
• What is MP MRI:

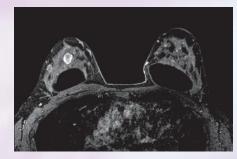
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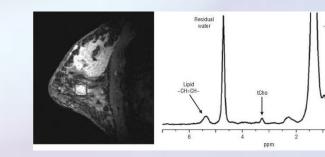
- T1-Weighted Imaging (T1WI)
- T2-Weighted Imaging (T2WI)
- Diffusion-Weighted Imaging (DWI)
- Dynamic Contrast-Enhanced Imaging (DCE)

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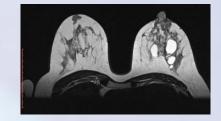
MR Spectroscopic Imaging (MRSI)











Why use MP-MRI?

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 T1 and T2WI give anatomical and structural information both of breast and tumour tissues.

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- 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

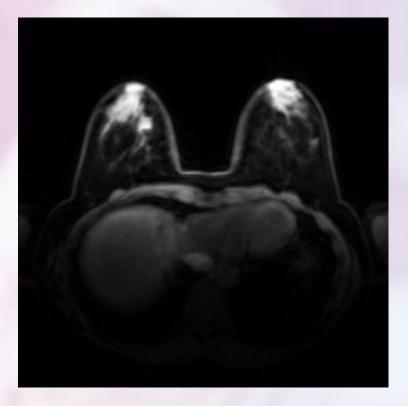
Relative amount of fibroglandular tissue and fat tissue

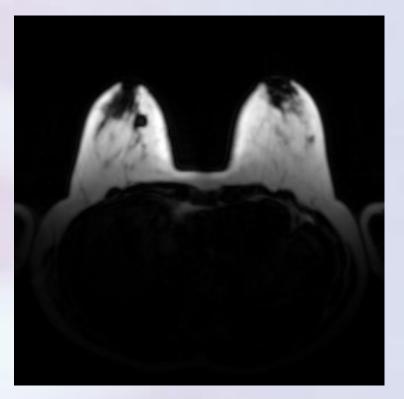
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- Quantitative measures to compute tissue breast density
- Compare with BI-RADS and DM/DBT measures
- Morphological characterisation of breast



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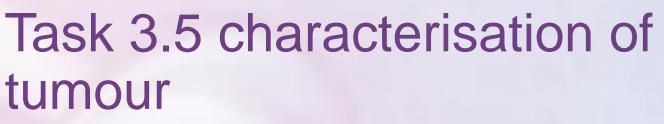




Water signal only

Fat signal only

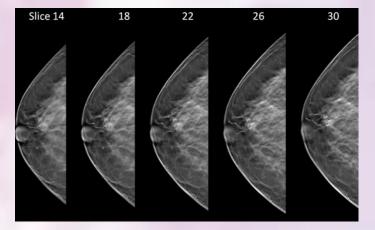


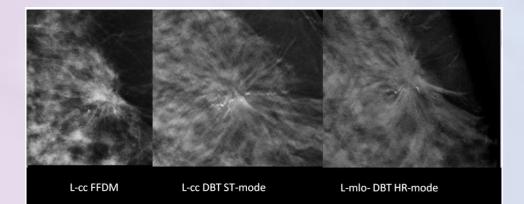


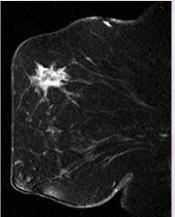
- Anatomy and physiology from MRI
- Tumour morphology, size, volume, spiculation MRI & DBT
- Tumour physiology from contrast pharmacokinetics Novel approaches needed here: rate of wash in/wash out, time to peak, time to plateau ...



3D morphology







• 3D visualisation, degree of circularity, spiculation





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- 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

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

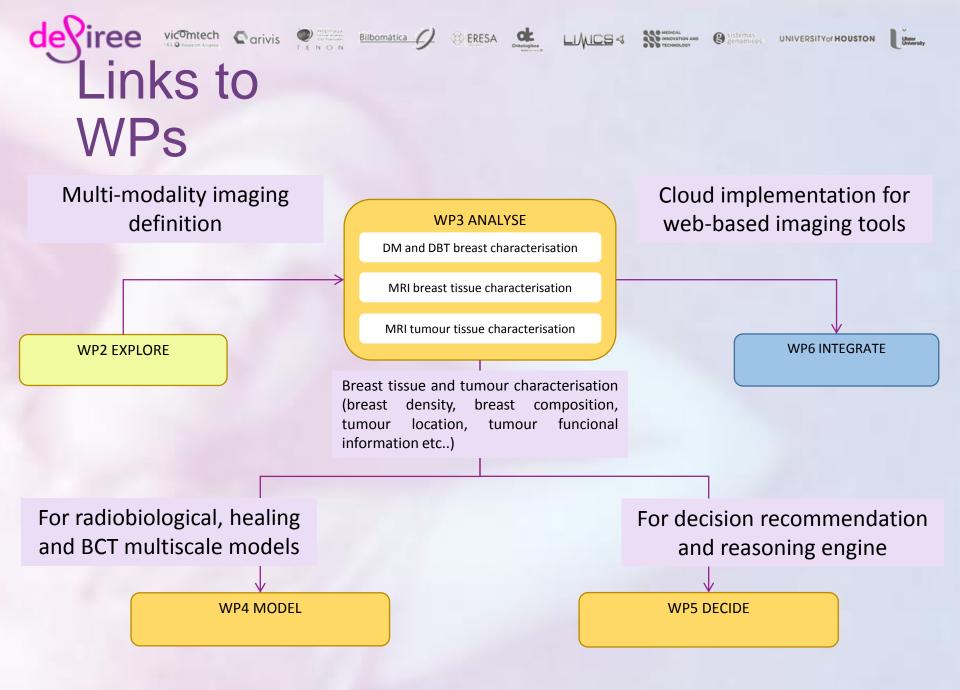
Require non-linear registration



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

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Clear parameters

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





Funded by the European Union

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Summary

- Novel approaches
- Multiparametric approach
- Objective outcomes