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PERSONALIZED MEDICINE:
In Pursuit of Excellence

Integrating bilateral information in the eigendetection CAD approach

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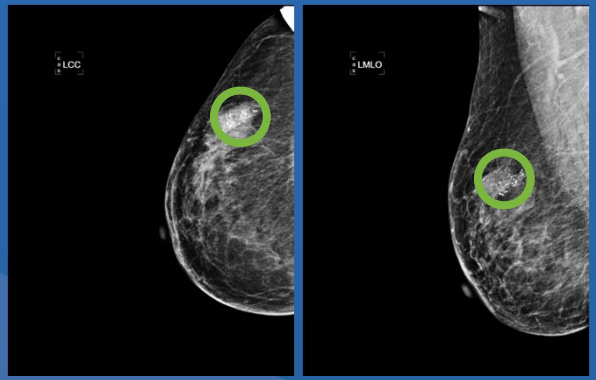
MOTIVATION

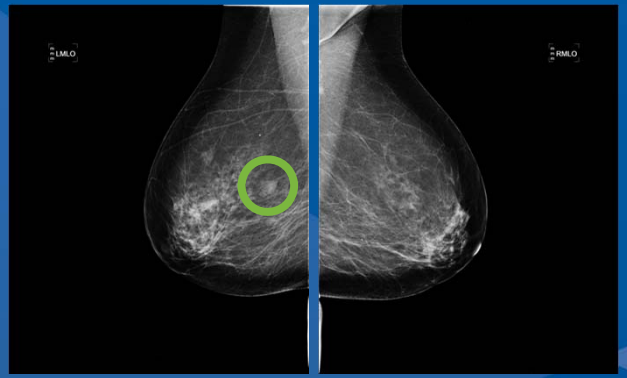
Screening Mammography Exam

Four images are typically acquired during a screening mammography exam, CC and MLO views from left and right breasts. These images are inspected by radiologists to find signs of potential lesions.

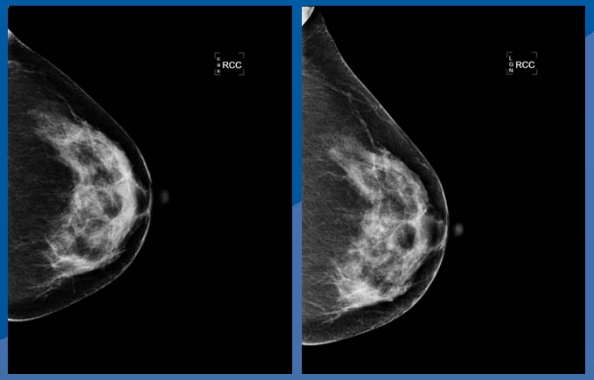
Mammographic Image Comparison



Ipsilateral comparison



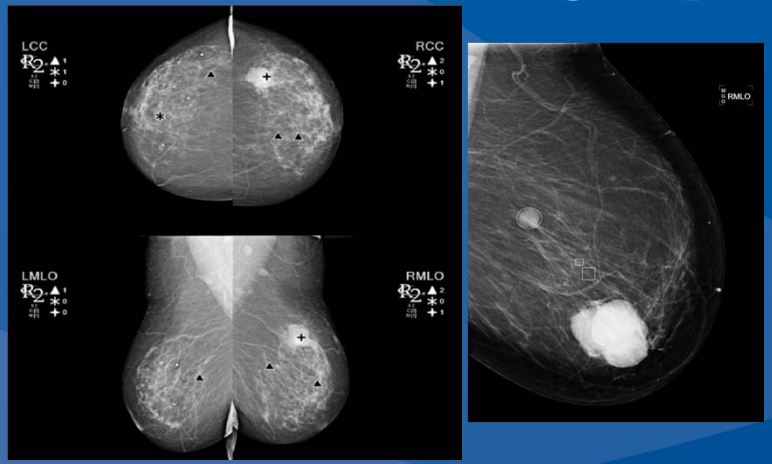
Bilateral comparison



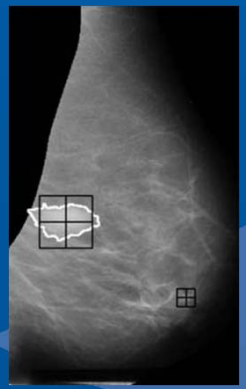
Temporal comparison

A common practice among radiologists during the image evaluation is to take not only single images but also multiple images of the same patient into account.

Computer Aided Detection (CAD) Mammographic Systems

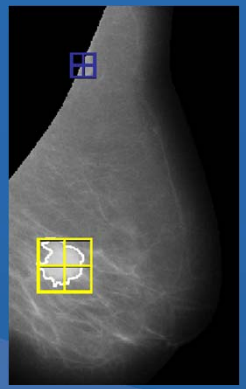


Commercial CAD Systems

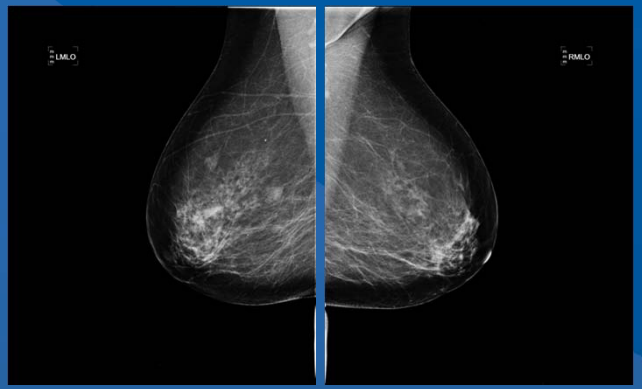


Our CAD System for detecting masses

CAD mammographic systems usually analyze each image independently. However, the radiologists use information coming from multiple images.



Our Single Image CAD System



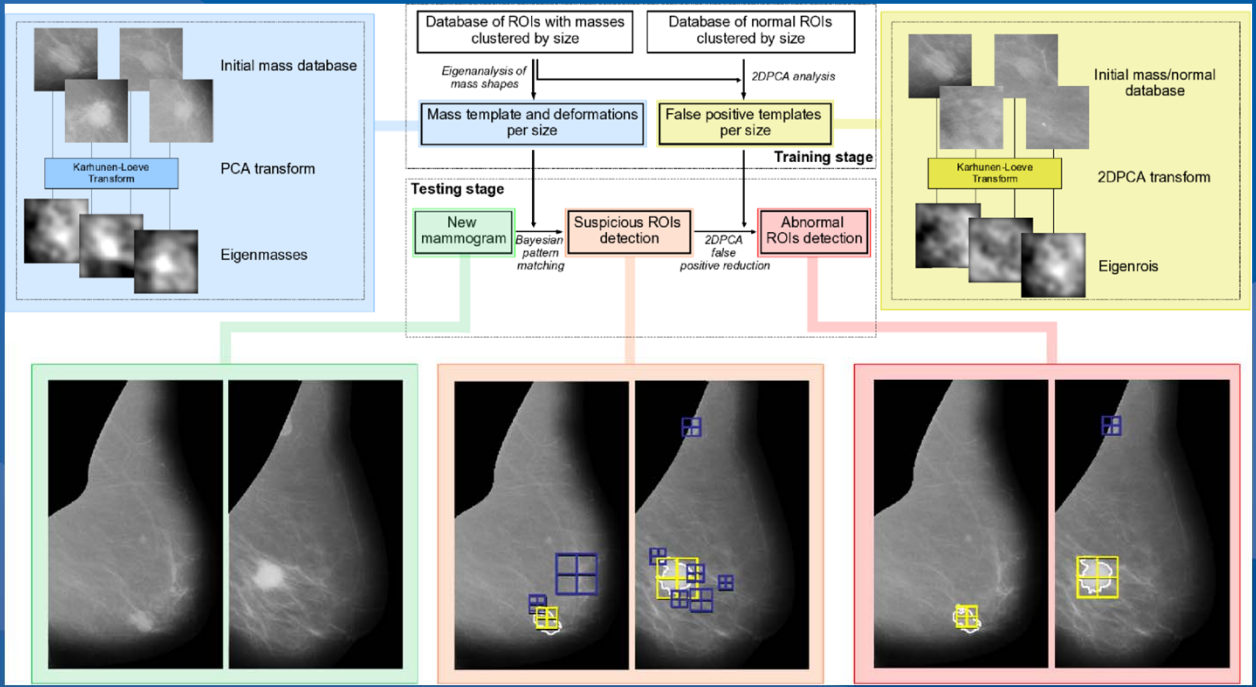
Bilateral Comparison

Dual Image CAD System

The main idea of our research work is to transform our single image CAD system into a dual image one by adding information about the differences between left and right breasts.

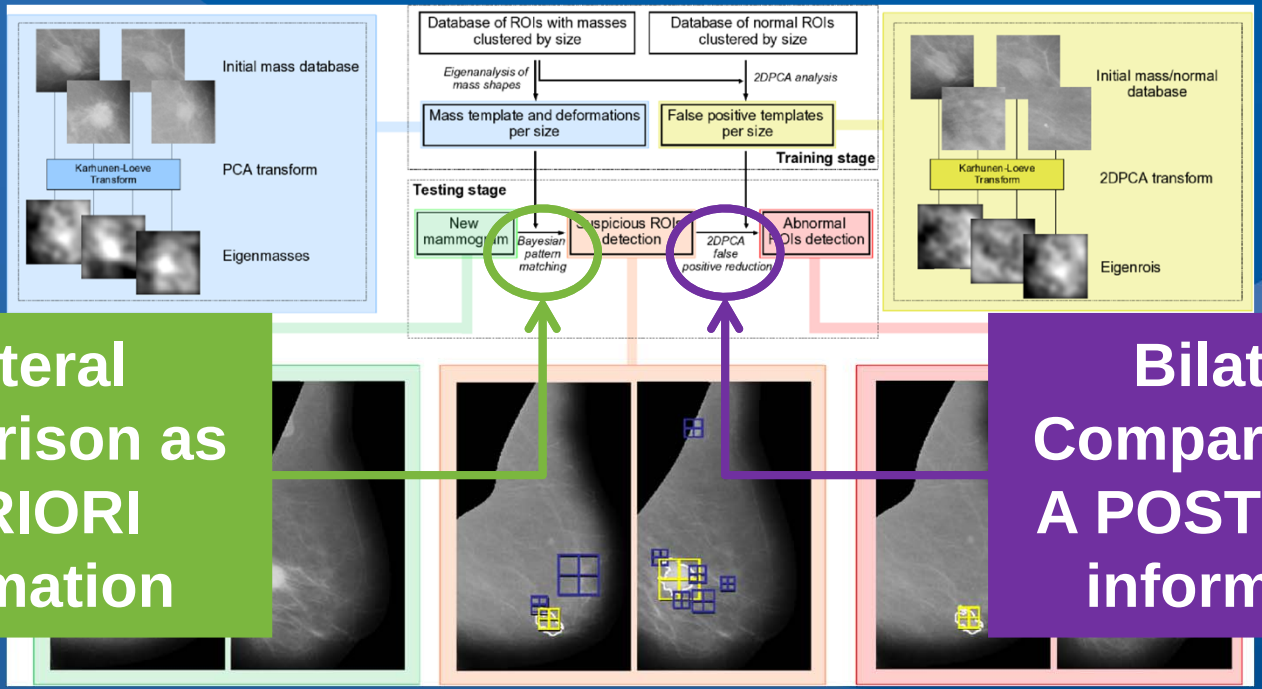
METHODOLOGY

Single Image CAD System



J. Freixenet, A. Oliver, et al., ”Eigendetection of masses considering false positive reduction and breast density information”, Med. Phys., vol.35, no.5, pp.1840-1853, 2008.

Dual Image CAD System

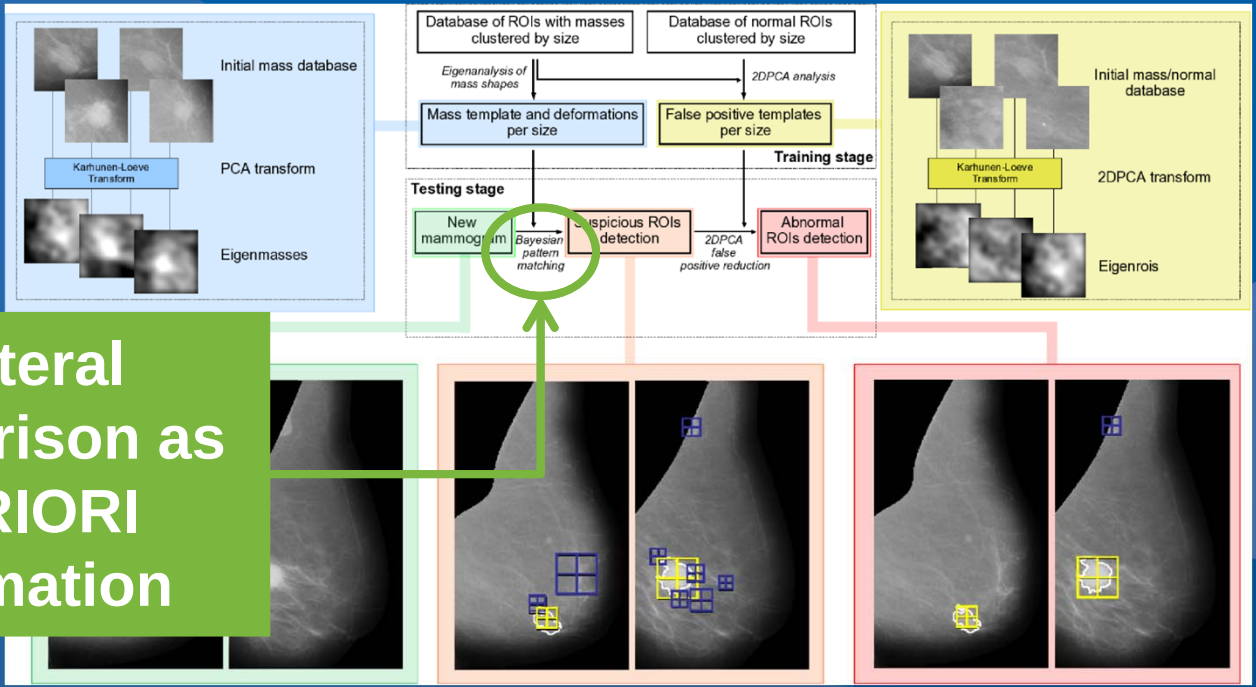


Bilateral Comparison as A PRIORI information

Bilateral Comparison as A POSTERIORI information

The bilateral information can be integrated as a priori information (during the detection stage) or as a posteriori information (during the false positive reduction stage).

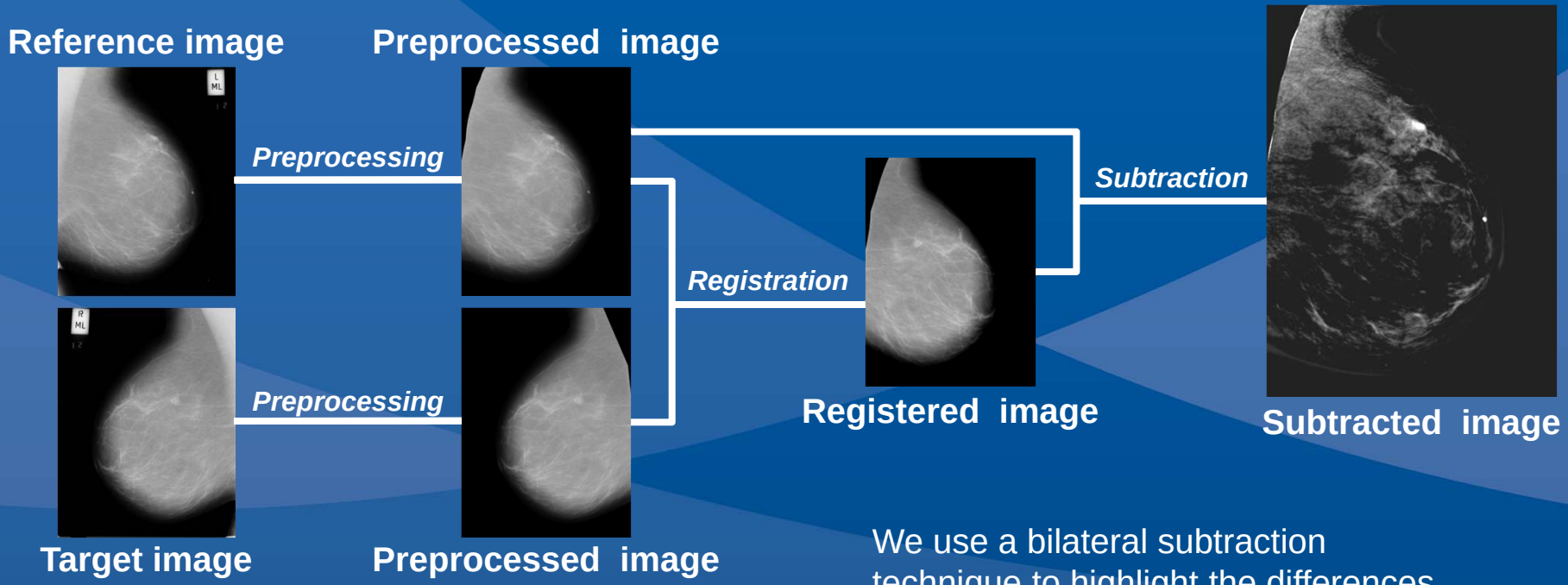
Dual Image CAD System



Bilateral Comparison as A PRIORI information

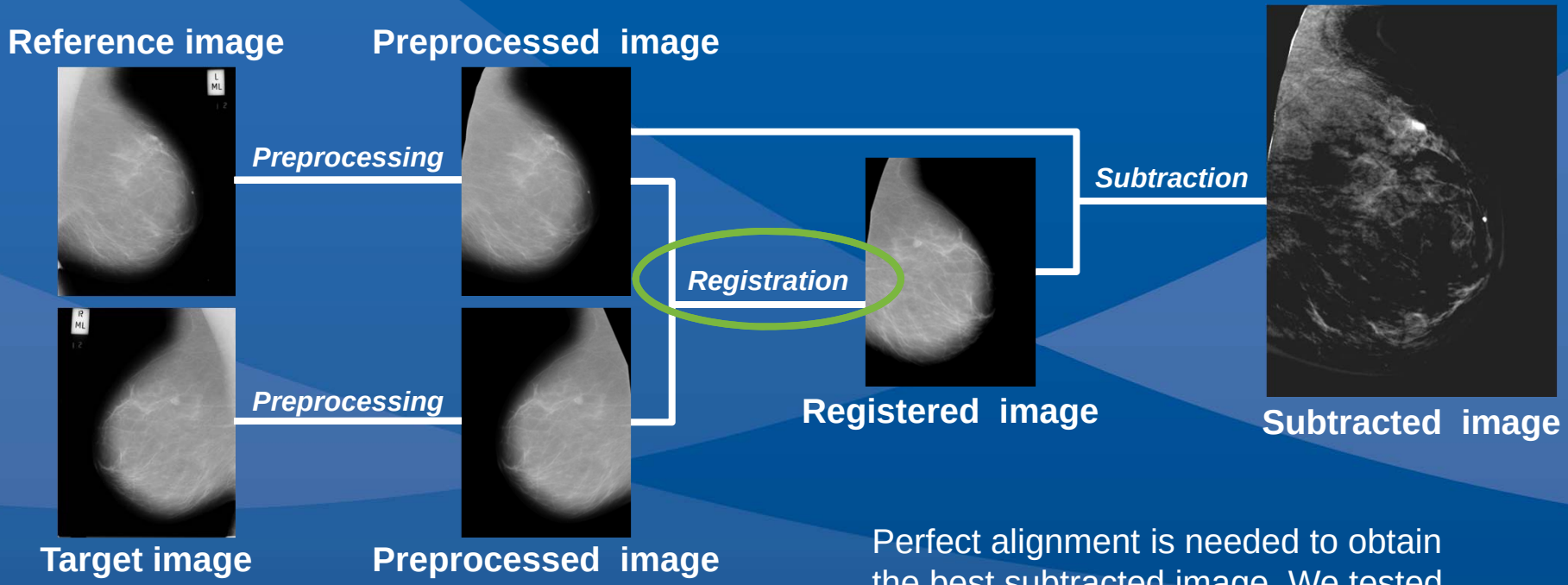
We will focus on the **A PRIORI** case.

Bilateral Comparison: Image Subtraction



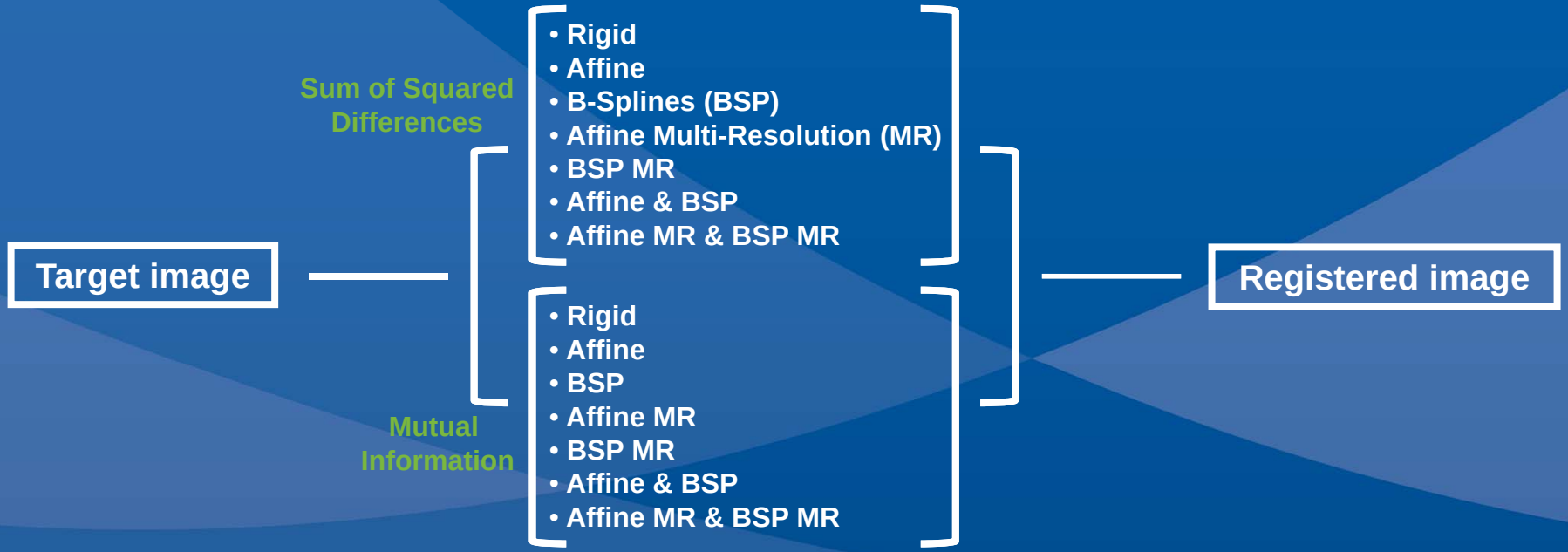
We use a bilateral subtraction technique to highlight the differences between breasts.

Bilateral Comparison: Image Subtraction



Perfect alignment is needed to obtain the best subtracted image. We tested several registration methods.

Registration Methods



We evaluated global and local registration methods, including multi-resolution approaches and several combinations. The transformation parameters are recovered by maximizing two different metrics.

RESULTS

Registration Evaluation (I)

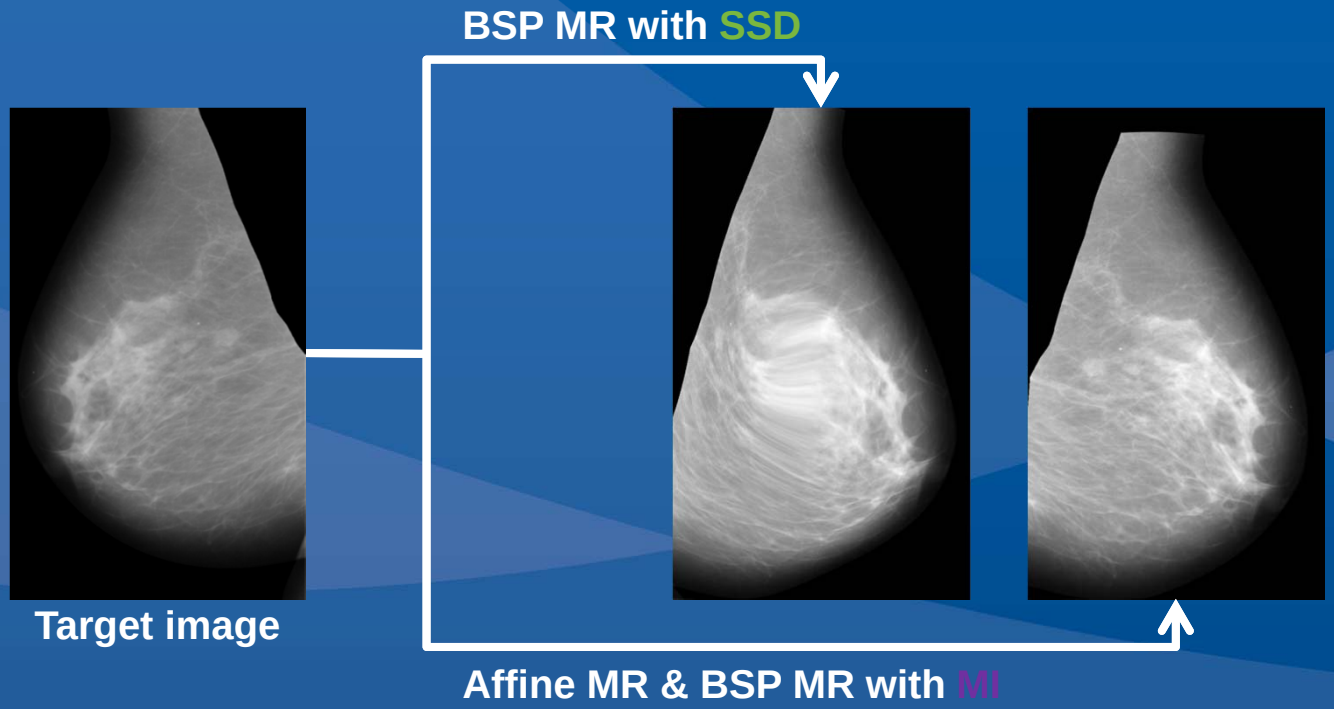
The evaluation was done using a set of 160 pairs of left and right MLO mammograms from the MIAS database.

For SSD: lower values indicate more similarity.

For MI: higher values indicate more similarity.

	Sum of squared differences		Mutual Information	
	Mean	Standard Deviation	Mean	Standard Deviation
Rigid	795.84	502.77	0.83	0.27
Affine	503.03	310.15	1.05	0.21
BSP	277.51	131.69	1.34	0.23
Affine MR	788.25	476.13	1.05	0.21
BSP MR	**218.56**	100.93	1.34	0.23
Affine & BSP	276.69	143.14	1.37	0.21
Affine MR & BSP MR	221.30	111.29	**1.38**	0.22

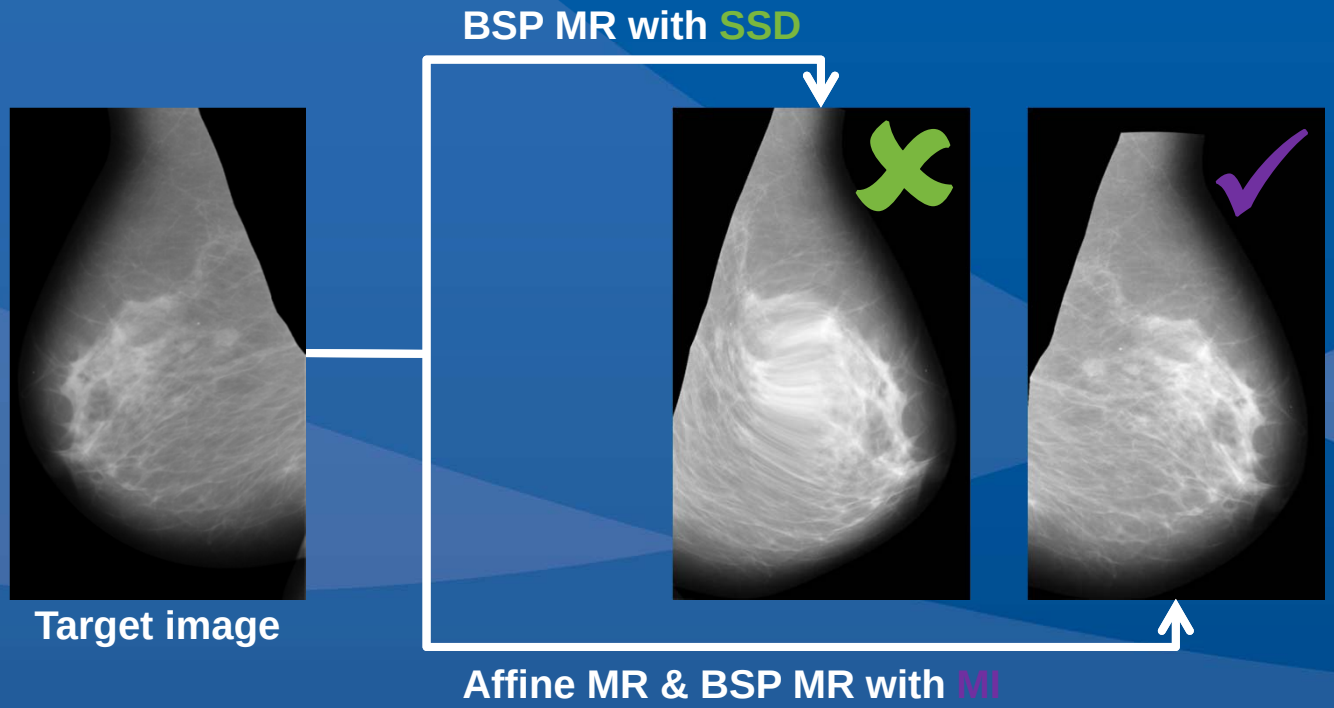
Registration Evaluation (II)



To determine the metric we performed a visual assessment.

MI provided better results than SSD.

Registration Evaluation (II)

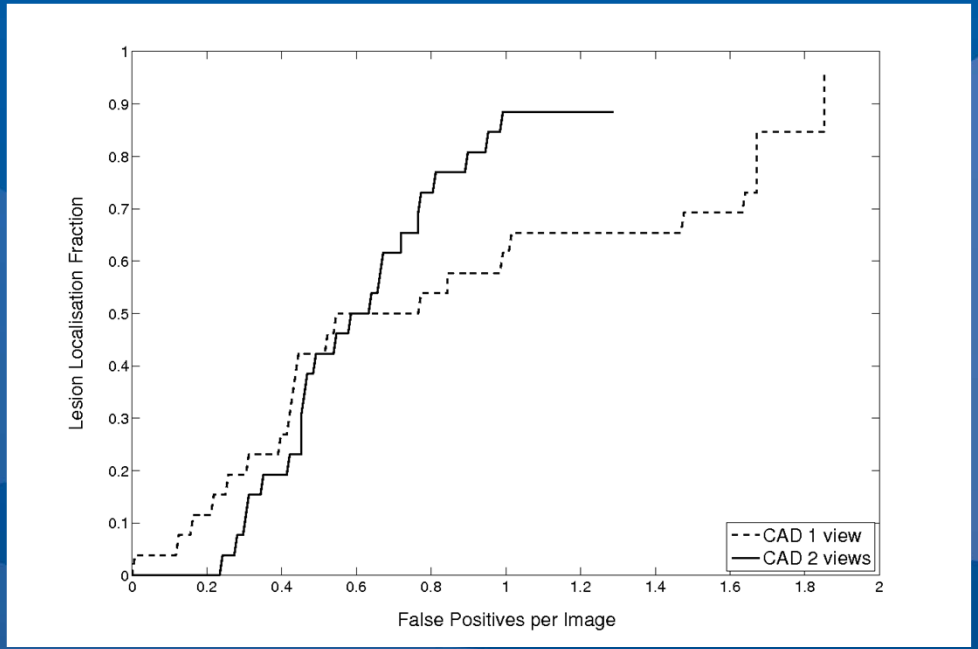


Therefore, Affine MR & BSP MR with MI was used in our experiments.

FROC analysis for CAD Evaluation

The evaluation was done in terms of FROC analysis using a set of 104 pairs of left and right MLO mammograms from the MIAS database containing 52 mammograms with at least one mass and a leave-one-pair-out methodology.

At higher sensitivities the dual image CAD improved the single image one. For instance, at a 88% of sensitivity, the false positives per image were 1.85 for the single system and 0.99 for the dual one.



CONCLUSIONS & FUTURE WORK

Conclusions

- Affine MR combined with BSP MR using Mutual Information as metric has provided the best results when registering bilateral images.

- Including bilateral comparison as *a priori* information has improved the performance of our single-image CAD system at higher sensitivities.

Further Work

- To evaluate the influence of introducing breast density information in the training step.

- To analyze the use of bilateral registration information as a false positive reduction method.

- To test our approach with a full-field digital database.