# Breast MRI Multi- Sequence Segmentation and Registration

João F. Teixeira, Sílvia Bessa, Hélder P. Oliveira
jpfteixeira.eng@gmail.com, silvia.n.bessa@inesctec.pt, helder.f.oliveira@inesctec.pt

## 1. Introduction

**Why segment and align *T1w* and *Sd0*?**

- Each acquires best different properties;
- *Sd0*: Lesions and internal tissues;
- *T1w*: Rigid anatomy
- Breast is largest object, easier to segment in both sequences.

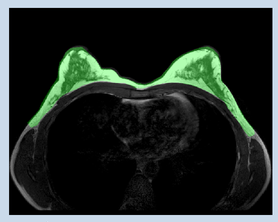
**Motivation:**
The fusion enables to use annotations from both, in a single 3D space.

**Challenge:**
Sequences have different FOVs and voxel resolution.

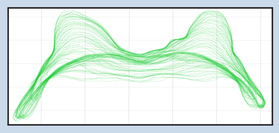
## 2. Dataset

**BCCT.plan project data:**

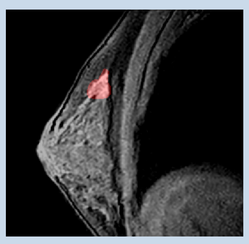
- 27 patients;
- *T1w*: 60 slices (∼3mm), $720 \times 720$ pixels (0.3-0.5 mm/px);
- *Sd0*: 300 slices (∼1mm), $300 \times 300$ pixels (0.5-0.6 mm/px);
- Clinical solid annotations.



a) *T1w* breast

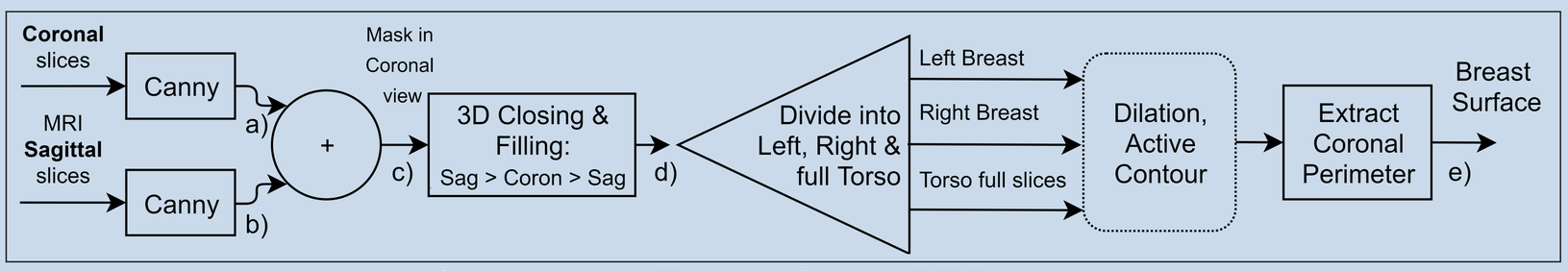


b) *T1w* breast perimeter



c) *Sd0* Lesion

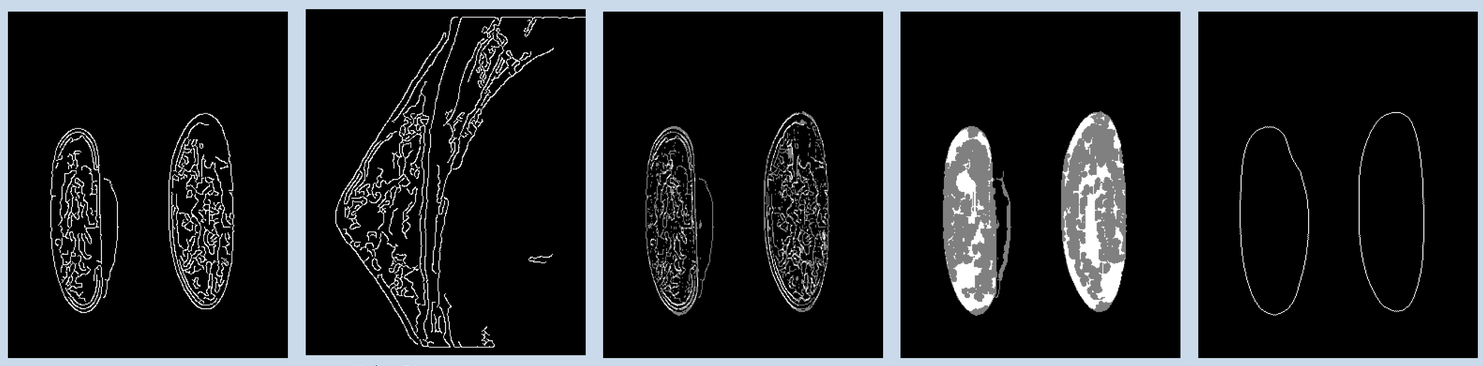
## 3. Pipeline




Segmentation Pipeline for one MRI sequence

### Tasks:

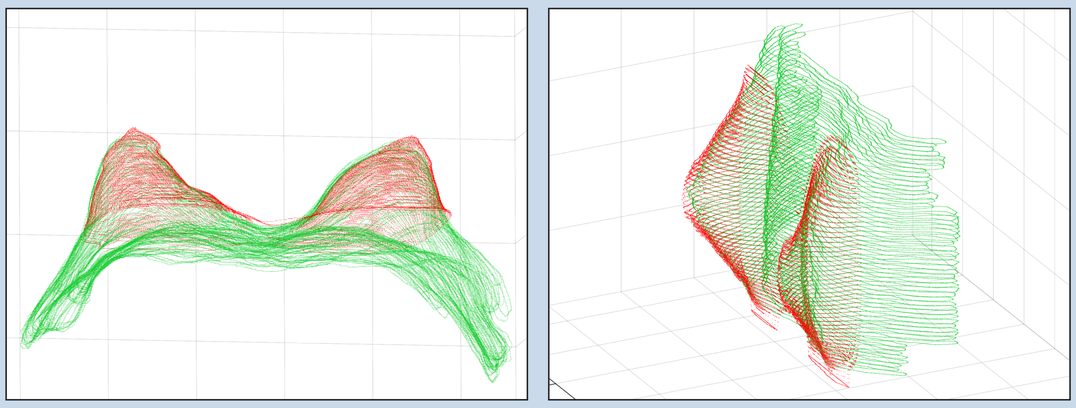
1. **Segment** *T1w* with the pipeline
2. **Segment** *Sd0* with the pipeline
3. **Register** both segmentation surfaces using Iterative Closest Point



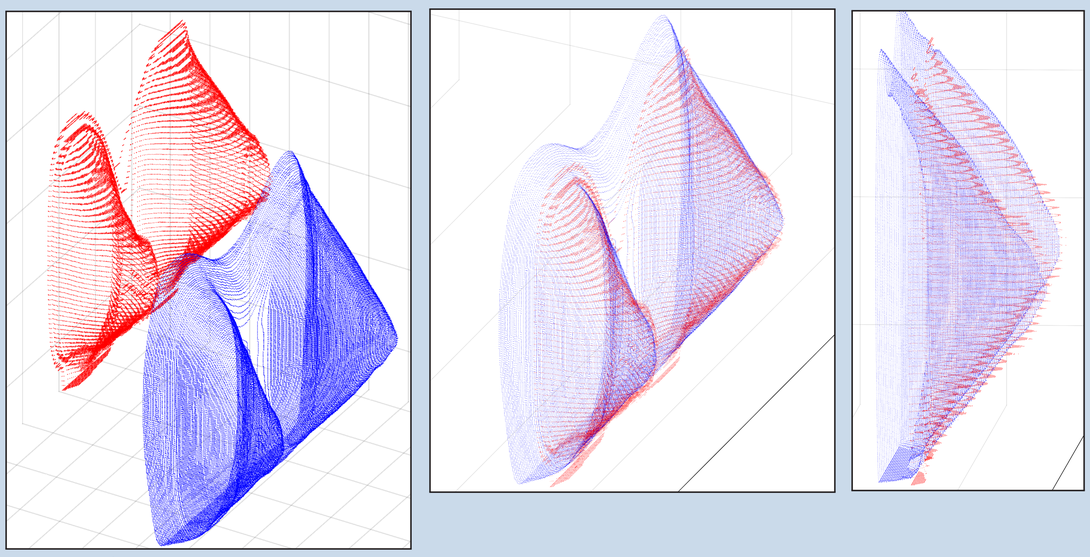
a) Canny Coronal | b) Canny Sagittal | c) Mask Coronal | d) Filling | e) 3D Coronal Perimeter

Pipeline intermediate results for *Sd0*

## 4.1 Visual Results



*T1w* Segmentation output (red) against GT contour (green)



a) Pre-Registered | b) Registered | c) Registered

Registration step. *T1w* (red), Registered *Sd0* (blue)

## 4.2 Quantitative results

Table 1: Segmentation and registration 3D errors

| | **Min** | **Avg. Dist.** | **AD** | **Max** |
|---|---|---|---|---|
| *T1w* to *T1wGT* | 1.23 | 2.20 (0.47) | *n.a.* | 3.05 |
| *Sd0* to *T1w* | 1.75 | 2.91(1.30) | 2.57 (1.01) | 6.17 |
| *T1w* to *Sd0* | 1.37 | 1.77 (0.47) | | 3.76 |

All metrics in mm (min is best). Avg. Dist. and AD present values averaged across all patients, and respective standard deviations in parenthesis.

## 5. Conclusions

**Discussion:**

**1.** Segm. maintained details on the infra-mammary folds;
**2.** *Sd0* follows the outer skin interface, while *T1w* follows the inner one;
**3.** Central slices' 2D error ∼4mm vs *T1w* 3mm thickness

**Conclusion:**

**1.** Perfect segmentation was not achieved:
**1.1.** Fails on lower intensity, transitional objects;
**1.2.** Fails detail on terminating slices' objects;
**2.** Segmentation results are enough for reliable registration.

## Acknowledgements

This work is financed by National Funds through the Portuguese funding agency, FCT - Fundação para a Ciência e a Tecnologia within project UIDB/50014/2020, and PhD grants number SFRH/BD/135834/2018 and SFRH/BD/115616/2016.