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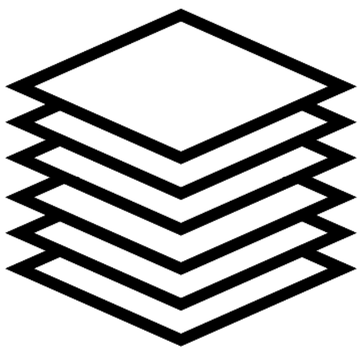
INESCTEC

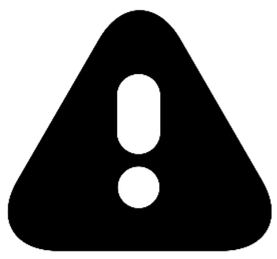
MASS SEGMENTATION IN MAMMOGRAMS
A CROSS-SENSOR COMPARISON OF DEEP AND TAILORED FEATURES

The need for CAD in Breast Cancer Screening



Large no. of mammograms to be analyzed every day

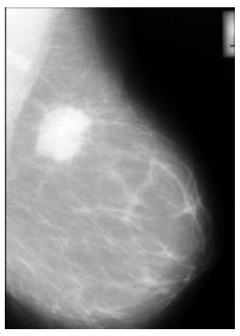
Exhaustive task, mammograms have low contrast



Prone to human errors / missing vital clues

Radiologists error rates are of **10%** to **30%** for detection of breast lesions in screening mammograms.

- **False Positive cases:** women undergo further unnecessary clinical evaluation or breast biopsy, which can lead to needless anxiety.
- **False Negative Cases**: the best time interval for the treatment of cancer can be missed, thus potentially endangering the patient.

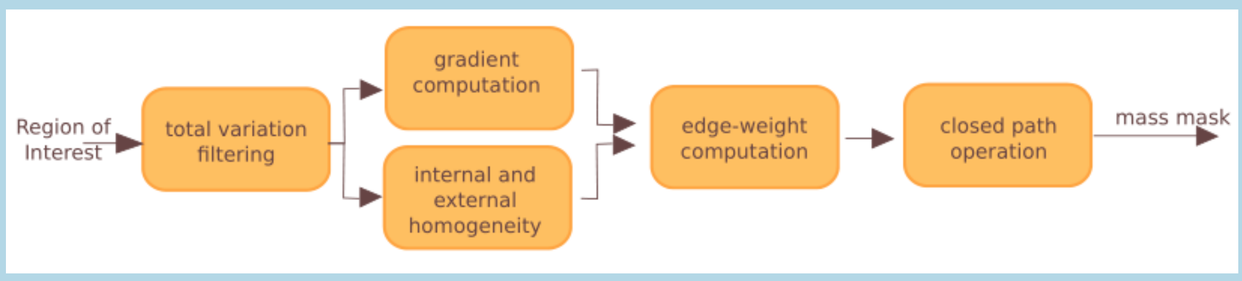


A fundamental stage in typical CAD systems is the **segmentation of masses** in regions of interest (ROIs)

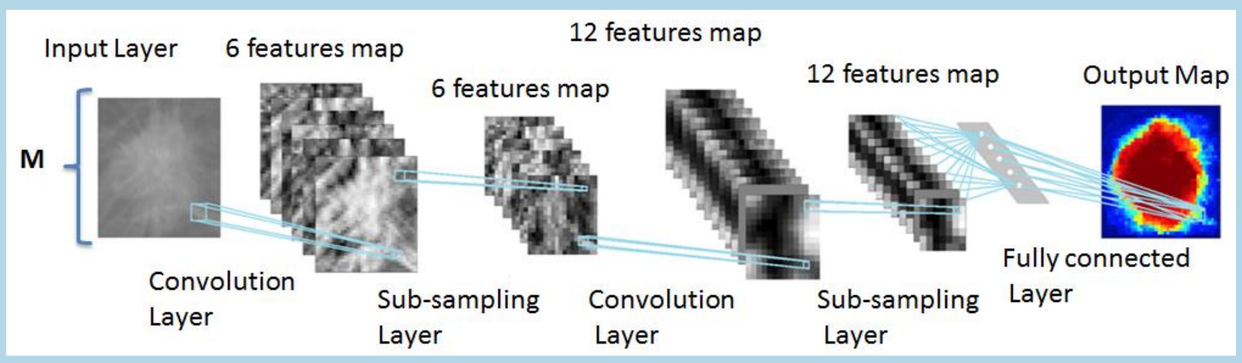
Limitations of Current CAD Approaches

- Evaluated in Small Datasets
- Optimistic estimation of performance

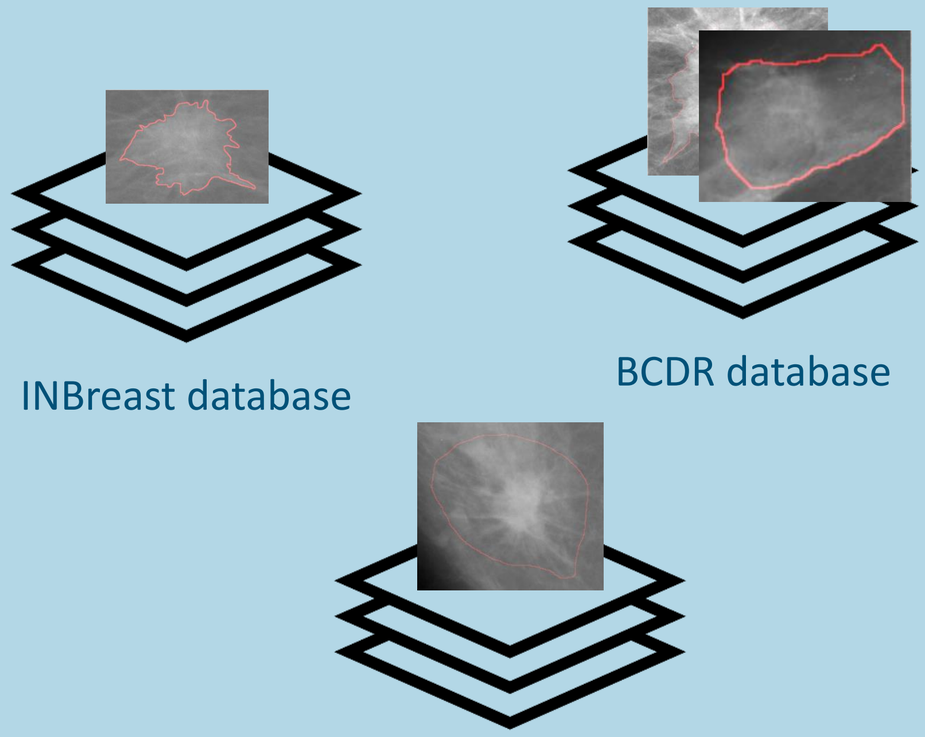
Material and Methods



Block diagram of the **improved closed path approach**



Block diagram of the **deep learning based approach**



Results

Table 1: Mass segmentation on Mammograms: Intra-sensor results. Results are the mean of the Dice metric (the higher the better).

Database	Original Closed Path	Improved Closed Path	SSVM	CRF
INBreast	0.88	0.89	0.90	0.90
BCDR-D01	0.84	0.87	0.88	0.89
BCDR-F02	0.72	0.77	0.83	0.82
DDSM-BCRP	0.52	0.87	0.90	0.90

Table 2: Mass segmentation on Mammograms: Cross-sensor results. Results are the mean of the Dice metric (in brackets is the decrease from the intra-sensor performance).

Train Database	Test Database	Improved Closed Path	SSVM	CRF
BCDR-D01	INBreast	0.89 (0.00)	0.82 (0.08)	0.81 (0.09)
BCDR-F02	INBreast	0.83 (0.06)	0.88 (0.02)	0.87 (0.03)
DDSM-BCRP	INBreast	0.83 (0.06)	0.87 (0.03)	0.87 (0.03)
INBreast	BCDR-D01	0.87 (0.00)	0.82 (0.06)	0.81 (0.08)
BCDR-F02	BCDR-D01	0.84 (0.03)	0.80 (0.08)	0.79 (0.10)
DDSM-BCRP	BCDR-D01	0.84 (0.03)	0.84 (0.04)	0.83 (0.05)
INBreast	BCDR-F02	0.75 (0.02)	0.77 (0.06)	0.80 (0.02)
BCDR-D01	BCDR-F02	0.75 (0.02)	0.77 (0.06)	0.76 (0.06)
DDSM-BCRP	BCDR-F02	0.77 (0.00)	0.81 (0.02)	0.81 (0.01)
INBreast	DDSM-BCRP	0.65 (0.22)	0.77 (0.12)	0.81 (0.09)
BCDR-D01	DDSM-BCRP	0.65 (0.22)	0.83 (0.07)	0.81 (0.09)
BCDR-F02	DDSM-BCRP	0.87 (0.00)	0.85 (0.05)	0.83 (0.07)

Discussion and Conclusions

- Improved Closed Path is much better than the original method
- The worst performances are obtained when transferring from INBreast to DDSM and from BCDR-D01 to BCDR-F02.
  - One of the reasons behind this performance drop lies in the annotation differences between those databases.
- The results improve from the film based to the digital mammography
  - the higher data quality of the digital mammograms pays off in the segmentation task.
- The fine-detailed segmentation of the (digital) INBreast database yields the best automatic segmentation model.