

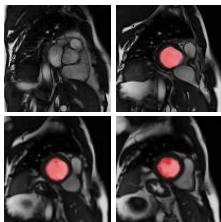
# Self-supervised Out-of-distribution (OOD) Detection for Cardiac CMR Segmentation

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## Background

- Vendor generalization for cardiac CMR is an open challenge

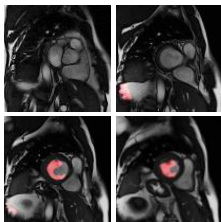
Model trained with  
Siemens Avanto (ID)



Dice: .96

Max.  $\sigma$ : .99 Ours: .72

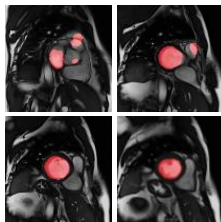
Model trained with  
Philips Achieva (OOD)



Dice: .73

Max.  $\sigma$ : .99 Ours: .38

Model trained with  
GE Signa (OOD)



Dice: .86

Max.  $\sigma$ : .99 Ours: .47

- Self-supervision increasingly popular

## Novelty calculation

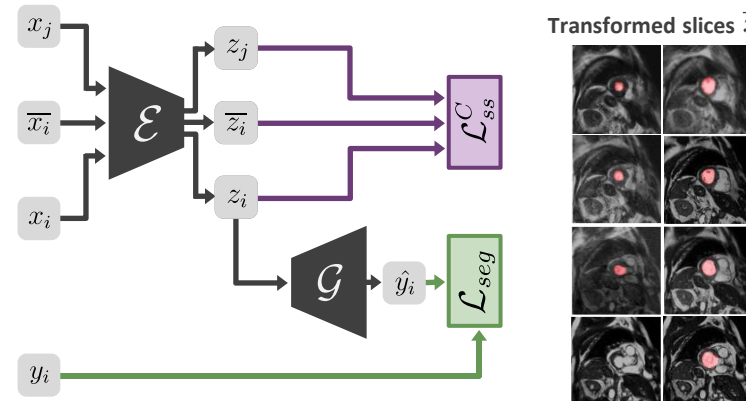
- DNNs fail for OOD data also for proxy tasks  $\rightarrow$  **Proxy loss during inference as novelty signal**
- Novelty:** Combination of **test-time proxy loss and uncertainty estimation**

$$\mathcal{N}(x_i) = \underbrace{\lambda \mathcal{L}_{ss}(\cdot)}_{\text{Proxy loss}} + \underbrace{\frac{1}{N} \sum_{j=1}^N \sqrt{\frac{1}{K} \sum_{k=1}^K (x_{i,j}^k - \mu_{i,j})^2}}_{\text{Uncertainty estimation (MC Dropout or Deep Ensembles)}}$$

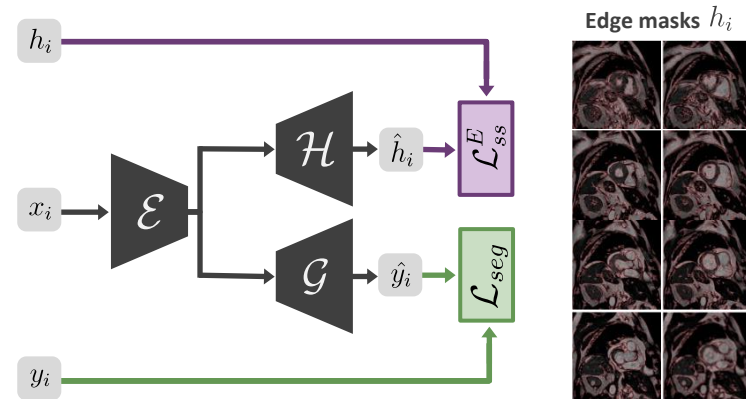
## Explored Architectures

Novelty function should work regardless of proxy task  $\rightarrow$  evaluation with 2 proxy tasks

**Contrastive Learning:** Disregard slight transformations in feature space



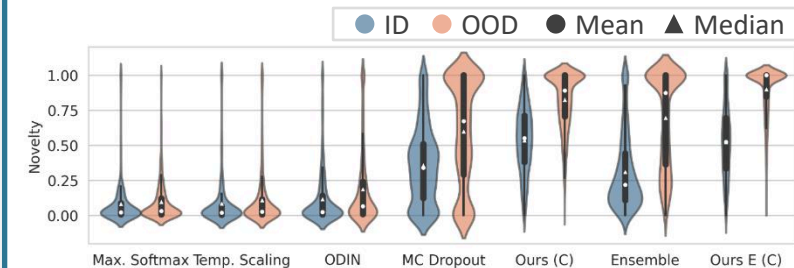
**Edge Detection:** Shared encoder, 2 decoders



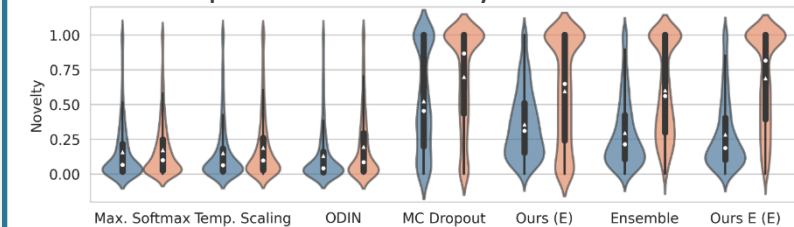
## Results

**Contrastive learning:**

- Our method has lowest Detection Error for 5 of 6 cases and lowest FPR for 6 of 6 cases
- Significant separation of novelty ranges



**Edge detection:** Higher Detection Error and FPR, also less separation in novelty distributions



## Conclusions

- Proxy loss** during inference
  - reliable **OOD signal**
  - lightweight
- Monitor alongside **uncertainty estimation**