

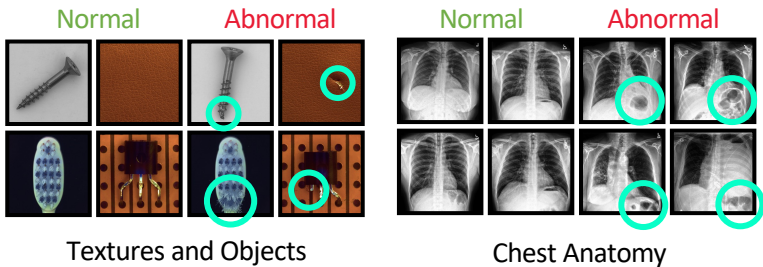
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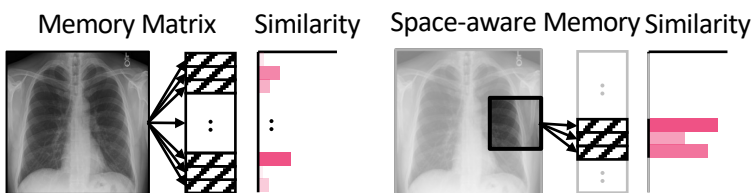
## Summary

**TL;DR** - We propose Space-aware Memory Queues for In-painting and Detecting anomalies from radiography images (SQUID). SQUID captures consistent structural patterns in X-rays and alerts on rarely structured ones.

**Challenge** - Anomaly detection in X-ray images can be both easier and harder than in photographic images. It is easier because X-ray images are spatially structured due to consistent imaging protocols. It is harder because anomalies in X-ray images are subtle and require medical expertise to annotate.



**Why chest X-rays are special?** - Spatial consistency! X-rays are well aligned with each other, which means regions at the same locations should all look similar. We can update existing methods in a space-aware manner.

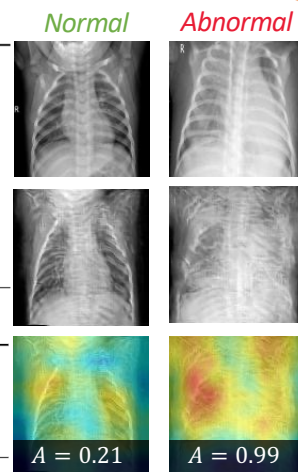


## Results

| ZhangLab      | Ref & Year | AUC (%)         | Acc (%)         | F1 (%)          |
|---------------|------------|-----------------|-----------------|-----------------|
| Auto-Encoder  | -          | 59.9            | 63.4            | 77.2            |
| VAE [34]      | Arxiv'13   | 61.8            | 64.0            | 77.4            |
| Ganomaly [1]  | ACCV'18    | 78.0            | 70.0            | 79.0            |
| f-AnoGAN [59] | MIA'19     | 75.5            | 74.0            | 81.0            |
| MemAE [16]    | ICCV'19    | 77.8±1.4        | 56.5±1.1        | 82.6±0.9        |
| MNAD [51]     | CVPR'20    | 77.3±0.9        | 73.6±0.7        | 79.3±1.1        |
| SALAD [79]    | TMI'21     | 82.7±0.8        | 75.9±0.9        | 82.1±0.3        |
| CutPaste [39] | CVPR'21    | 73.6±3.9        | 64.0±6.5        | 72.3±8.9        |
| PANDA [54]    | CVPR'21    | 65.7±1.3        | 65.4±1.9        | 66.3±1.2        |
| M-KD [57]     | CVPR'21    | 74.1±2.6        | 69.1±0.2        | 62.3±8.4        |
| IF 2D [48]    | MICCAI'21  | 81.0±2.8        | 76.4±0.2        | 82.2±2.7        |
| PaDiM [11]    | ICPR'21    | 71.4±3.4        | 72.9±2.4        | 80.7±1.2        |
| IGD [9]       | AAAI'22    | 73.4±1.9        | 74.0±2.2        | 80.9±1.3        |
| SQUID         | -          | <b>87.6±1.5</b> | <b>80.3±1.3</b> | <b>84.7±0.8</b> |

| CheXpert      | Ref & Year | AUC (%)         | Acc (%)         | F1 (%)          |
|---------------|------------|-----------------|-----------------|-----------------|
| Ganomaly [1]  | ACCV'18    | 68.9±1.4        | 65.7±0.2        | 65.1±1.9        |
| f-AnoGAN [59] | MIA'19     | 65.8±3.3        | 63.7±1.8        | 59.4±3.8        |
| MemAE [16]    | ICCV'19    | 54.3±4.0        | 55.6±1.4        | 53.3±7.0        |
| CutPaste [39] | CVPR'21    | 65.5±2.2        | 62.7±2.0        | 60.3±4.6        |
| PANDA [54]    | CVPR'21    | 68.6±0.9        | 66.4±2.8        | 65.3±1.5        |
| M-KD [57]     | CVPR'21    | 69.8±1.6        | 66.0±2.5        | 63.6±5.7        |
| SQUID         | -          | <b>78.1±5.1</b> | <b>71.9±3.8</b> | <b>75.9±5.7</b> |



## DigitAnatomy



**DigitAnatomy** is designed to resemble traits of chest X-rays but in a more interpretable manner. This helps debug.

## SQUID

SQUID has 3 stages:

- Feature extraction;
- Image reconstruct;
- Anomaly detect.

Techniques include:

- Space-aware mem;
- Memory queue;
- Feature in-paint;
- Gumbel shrinkage;
- Masked shortcut;
- And more!

