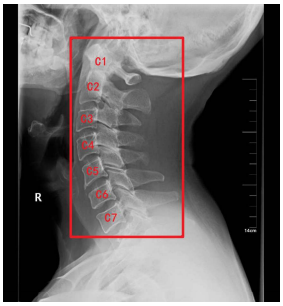
Class Activation Mapping-guided Delineation of ROI in Medical Images for Automatic Local Contrast Enhancement in Lateral Cervical Spine Radiographs

Jingyao XU, Meng ZHANG, Fumin ZHANG

Background

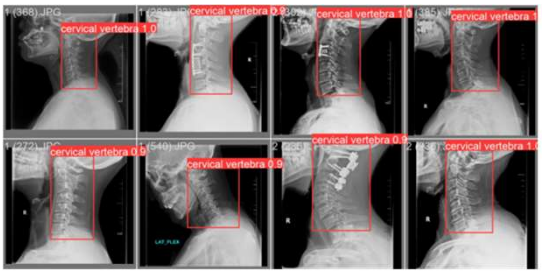
Clinical reading of lateral cervical spine radiographs often requires manual contrast adjustments to highlight regions of interest (ROIs), but automatic enhancement schemes may introduce issues like over-enhancement, under-enhancement, noise amplification, and poor ROI-background separation.

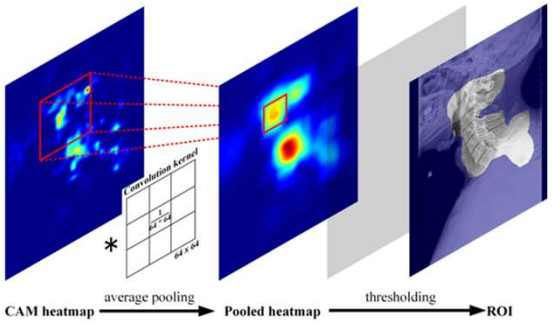
Objective: to enhance the ROI region solely

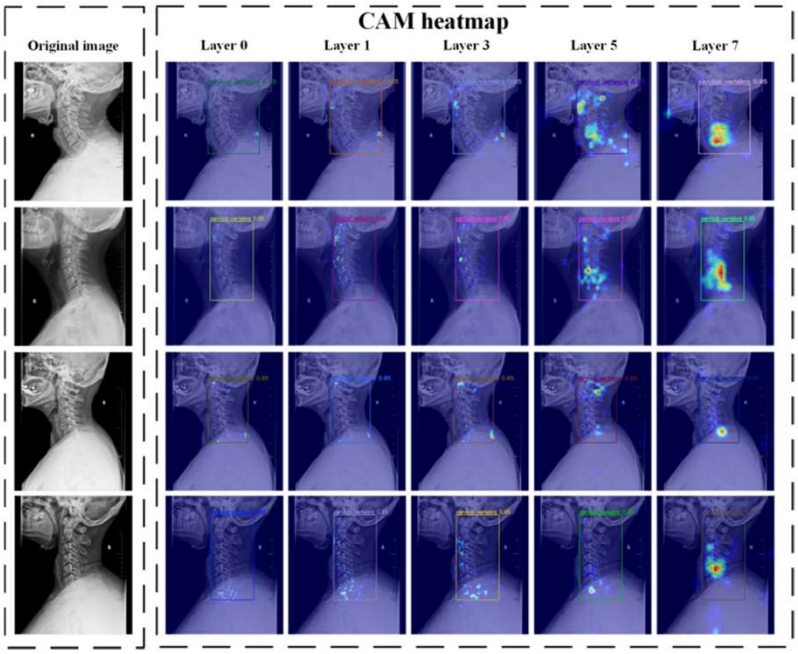


Methods

- A **target detector** for the C1-C7 vertebrae was trained using 1,000 images.
- **Class Activation Mapping** (HiResCAM) for delineating vertebral regions by highlighting shallow features in a convolutional neural network.
- **Local contrast enhancement** for improving the readability of vertebral areas, avoiding noise amplification.
- Pixel-level **alpha blending** for smoothing boundaries between the ROI and background.







Results

Experimental evaluations on medical images showed that the proposed method significantly enhances the readability of vertebral areas without compromising peripheral information, outperforming previous methods.

Better local visibility

Conclusion

The proposed scheme effectively automates contrast enhancement in lateral cervical spine radiographs, providing human-like focus on ROIs and avoiding common pitfalls in existing methods.