Robust MSFM Learning Network for Classification and Weakly Supervised Localization

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INTRODUCTION

- Accurate classification and precise localization of bone fractures in X-ray images are crucial for medical diagnosis and treatment.
- Current state-of-the-art classification methods prioritize accuracy but lack reliability.
- Existing approaches for fracture localization often require costly annotated data.
- We proposed Multistage Feature Map (MSFM) learning network.

This approach aims to enhance both classification accuracy and localization in weakly-supervised manner without relying on costly annotated bounding boxes.

- A feature augmentation technique is introduced to focus the model on discriminative regions, refining localization.
- Experiments conducted on the MURA dataset, covering diverse X-ray images, showcase the effectiveness of the MSFM model.
- The MSFM model holds potential for advancing the medical image classification and localization.

METHODOLOGY

Class activation map decomposition [1]

\[ CAM(X) = \frac{\partial F(X)}{\partial W} \]

For activation map, \( A = |F(X)|^\top M_{ij} \) is the possible resgion to localize.

\[ M_{ij} = \begin{cases} 1, & \text{if } A_{ij} \geq A \text{ for a specific class} \\ 0, & \text{otherwise} \end{cases} \]

Multi-stage feature map learning (MSFM) network architecture

SUMMARY AND CONCLUSIONS

- The proposed Multistage Feature Map (MSFM) learning network offers a robust solution for bone fracture classification and localization in X-ray images, surpassing the limitations of existing methods that rely on annotated bounding boxes.
- MSFM builds upon CAM, utilizing feature map-based activation (A) and class feature map (F) to capture comprehensive object information. By incorporating multiple stages, MSFM enhances robustness to image variations and extends the applicability of CAM to the entire object.
- The paper's contributions encompass the development of the MSFM-network architecture, a novel weakly supervised fracture localization technique, a feature augmentation method, and an extensive analysis of loss functions.
- Through comprehensive experiments, the proposed MSFM model achieves state-of-the-art results on the standard MURA dataset, which includes the elbow, finger, forearm, humerus, shoulder, wrist, hand, and bone tumor dataset, enhancing both classification accuracy and detection/localization in X-ray images, ultimately helping in patient care and outcomes in the field of medical image analysis.
- Our future endeavors involve extending the application of the MSFM model to a wide range of medical image datasets. This expansion will encompass moving beyond pretrained models and exploring more advanced backbones.

REFERENCES


