

互動式-脊椎關鍵點偵測

Interactive Vertebrae Keypoint Estimation

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Abstract

本專題利用深度學習及卷積神經網路技術，幫助醫療人員在脊椎醫學影像上進行每節椎體角落的偵測與標記，並以神經網路和使用者「互動」的方式進行偵測。

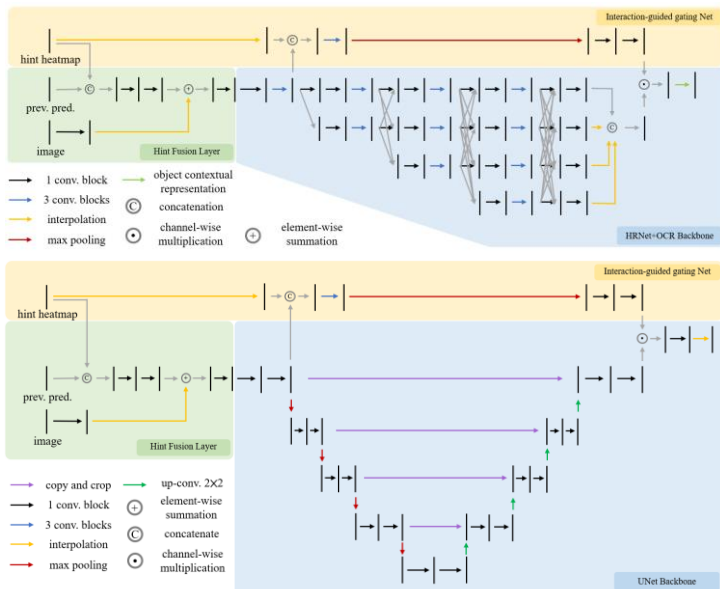
我們實驗兩種結構不同的互動式模型，可以快速並準確地辨識出椎體之關鍵點，且當偵測結果的關鍵點位置不如預期時，可以修正單一關鍵點位置並讓模型進行再偵測，神經網路將藉由修正提示自動調整其他關鍵點位置，以達到快速標記的效果。

Dataset

我們使用 AASCE 資料集，共包含 609 張 AIS 患者的人體正面 X 光影像，訓練 417/驗證 64/測試 128。關鍵點主要為胸椎(T1-T12)至腰椎(L1-L5)，共 17 節椎體的四個角落，總計 68 個關鍵點。



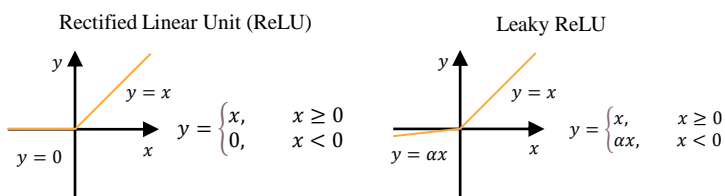
Network structure



互動式關鍵點偵測模型架構

HRNet+OCR IKEM (上)、UNet IKEM (下)

Activation function



Model training

Loss function :

$$L_{method1} = L_{heatmap} = -\frac{1}{N} \sum_{i=1}^N [y_i \cdot \log(\hat{y}_i) + (1 - y_i) \cdot \log(1 - \hat{y}_i)]$$

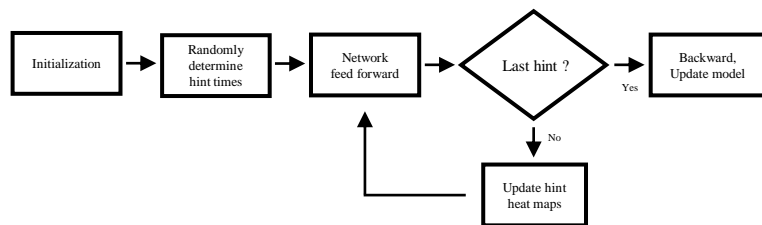
$$L_{method2} = L_{heatmap} + \alpha \cdot L_{morph}, \quad L_{morph} = L_d + \lambda \cdot L_a$$

Evaluation metric :

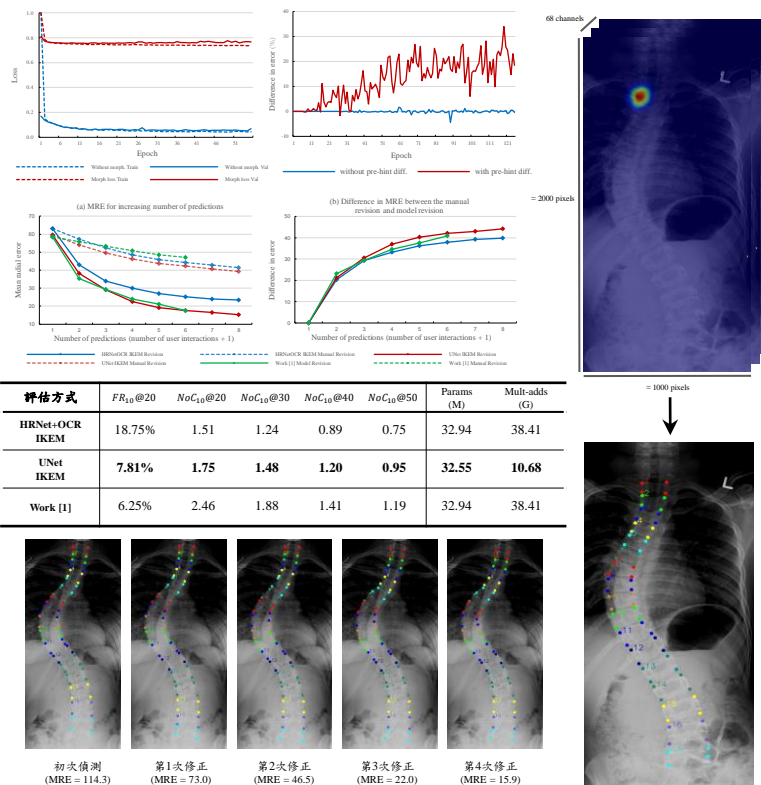
$$\text{Mean Radial Error : MRE} = \frac{1}{N} \sum_{n=1}^N \|k_{label} - k_{pred}\|_2$$

$$\text{Failure rate : } FR_{\alpha} @ \beta, \quad \text{Number of clicks : } NoC_{\alpha} @ \beta$$

Training method flow chart :



Experiment & Final result



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- Wu, H., Bailey, Chris., Rasoulinejad, Parham., and Li, S., 2017. Automatic landmark estimation for adolescent idiopathic scoliosis assessment using boostnet. *Medical Image Computing and Computer Assisted Intervention*:127-135.
- Ronneberger, O., Fischer, P., & Brox, T. (2015). U-net: Convolutional networks for biomedical image segmentation. In *Medical Image Computing and Computer-Assisted Intervention-MICCAI 2015: 18th International Conference, Munich, Germany, October 5-9, 2015, Proceedings, Part III 18* (pp. 234-241). Springer International Publishing.