Merged 1D-2D Deep Convolutional Neural Networks for Nerve Detection in Ultrasound Images

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UGRA limitations Objectives

Ultrasound Guided Regional Anesthesia (UGRA)

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UGRA UGRA limitations Objectives

Limitations:

- The need of high level of surgical skills and requires a long learning process.
- The difficulty of locating the nerve.





UGRA UGRA limitations Objectives

The paper objectives:

Objectives:

- Precise nerve detection in US images using robust merged CNNs model.
- Addressing medical application (Regional anesthesia).

Nerve characteristics Texture analysis The merged CNNs

Nerve characteristics:

- Presence of noise.
- Shape deformation.
- Texture properties.

Texture descriptor:

- Robust to noise.
- Robust to shape deformation.



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Nerve characteristics Texture analysis The merged CNNs

Robust Adaptive Median Binary Patterns (RAMBP)

RAMBP:

- Robust descriptor for different high noises.
- Captures microstructure and macrostructure texture information.



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Nerve characteristics Texture analysis The merged CNNs

The merged CNNs

- Learn high-level features from different dimensional data.
- Two branches:
 - 1D CNN branch (RAMBP 1D histograms)
 - 2D CNN branch (2D US images)



The merged CNNs performance

The merged CNNs performance for nerve detection



Method	precision	recall	F1-score
1D CNN	0.82	0.84	0.83
2D CNN	0.85	0.87	0.86
Our method (merged CNN)	0.96	0.95	0.96
1D DenseNet	0.80	0.80	0.79
2D DenseNet	0.84	0.83	0.84
Our method (merged DenseNet)	0.94	0.92	0.93
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The merged CNNs performance

Nerve detection using the merged CNN model.

Nerve detection results using the merged CNNs model (red rectangle for the merged model results and green rectangle for the groundtruth).

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Conclusions

- Learning high-level features.
- Merging RAMBP feature descriptor with CNN models to :
 - Accurate and consistent nerve detection.
 - $\bullet~>90\%$ precision for nerve detection and outperformed traditional CNNs by 10%.

Perspectives

• Assessing the detection techniques on other types of nerves.

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Conclusions

Thank you

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