

**ℓ_1 DecNet+: A new architecture framework by
 ℓ_1 decomposition and iteration unfolding for sparse feature
segmentation**

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Feature extraction in current segmentation networks are usually general purpose oriented, and mathematical image prior is rarely taken into network design. In this paper, we first introduce ℓ_1 DecNet as an unfolded network derived from a variational decomposition model incorporating sparse regularization. This architecture combines the benefits of mathematical modeling and data-driven approaches. We evaluate the effectiveness of ℓ_1 DecNet+ on two commonly encountered sparse segmentation tasks: retinal vessel segmentation in medical image processing and pavement crack detection in industrial abnormality identification. Experimental results on different datasets and segmentation bases demonstrate that, while obtaining overall accuracy improvement, our ℓ_1 DecNet+ architecture reduces greatly the number of learnable parameters and computational cost during inferences. This leads to especially practical advantages on resource-constrained devices. The preservation of the sparsity assumption from the mathematical model is confirmed through iteration unfolding and network training, and validated by visualization and statistical analysis of the extracted sparse features.

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