Infrared and visible image fusion is a fundamental task for image processing to enhance the image quality. To highlight target and retain effective details, different from previous methods using integer gradients, we use the fractional gradient to well represent image features and propose a novel fractional optimization model to fuse infrared and visible images. Specially, a fractional optimization function is designed with global contrast fidelity and fractional gradient constraint to obtain the pre-fused image. Then, the base layer of the pre-fused image obtained by multi-level decomposition latent low-rank representation is taken as the fused base layer, while for the fusion of detail layers, a fractional gradient energy function is designed to evaluate the importance of detail information to generate the fused detail layers. Compared with 30 state-of-the-art image fusion methods qualitatively and quantitatively on two public datasets (TNO and RoadScene), our method generally shows superior performance.

**Motivation**

- To alleviate the problem that the general base layer fusion rules easy to ignore the global contrast, we regard the fusion of the base layer as an optimization problem, which uses fractional gradient to better represent image features.
- To sufficiently extract the useful detail information, a fractional gradient energy function is designed to distribute the weight of detail information and generate the fused detail layers.

**Model architecture**

Infrared and visible image fusion generation based on fractional optimization

Visible image

Pre-fused image (generated based on fractional optimization)

Infrared image

Fractional fusion

Details fusion

Base layer

Reconstruction

Pre-fused image

Image fusion based on adaptive fractional strategy

Fig. 1. The overview of the proposed method. Specially, a optimization function is designed with global contrast fidelity and fractional gradient constraint, and a Sylvester-based optimization method is used to obtain the pre-fused image. Then, the base layer of the pre-fused image obtained by MDLatLRR is taken as the fused base layer. For the fusion of detail layers, the fractional gradient energy function is introduced to evaluate the importance of detail information to generate the fused detail layers. Finally, the fused image is reconstructed by the fused base layer and detail layers.

The fusion of base layer

The fusion of detail layers

The fused image

Ablation study

Conclusion

Propose a fractional gradient optimization function to obtain a pre-fused image, and the base layer of the pre-image obtained by using MDLatLRR is used as the fused base layer.

Design a fractional gradient energy function to retain important detail features for the fusion of detail layers.

Propose a novel fractional optimization model for infrared and visible image fusion. The experimental results show that the proposed method has good qualitative and quantitative performance on two public datasets (TNO and RoadScene).