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A New Fusion Method For Remote Sensing Images Based On Salient Region Extraction

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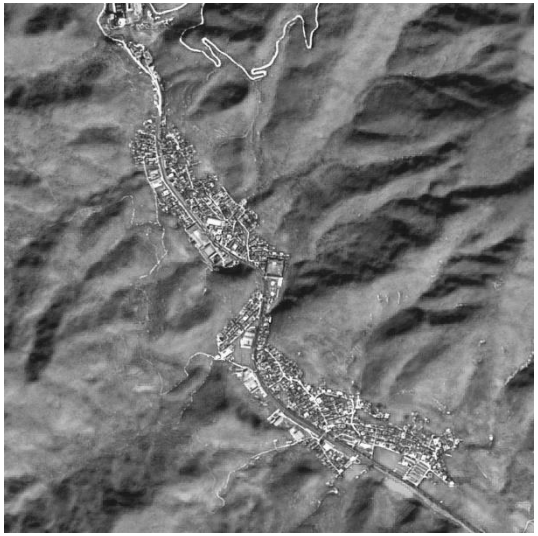
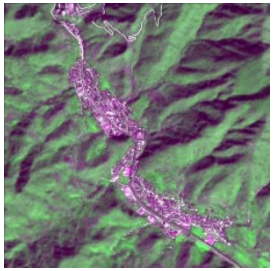
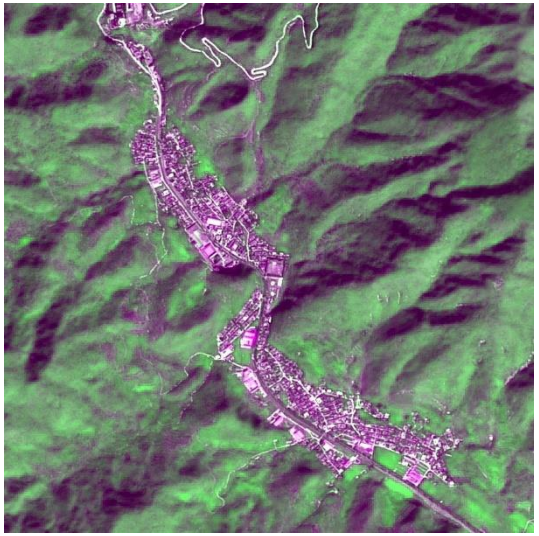
1 Introduction

1.1 Background



Remote sensing image fusion (Pansharpening)





Panchromatic Image

High spatial resolution

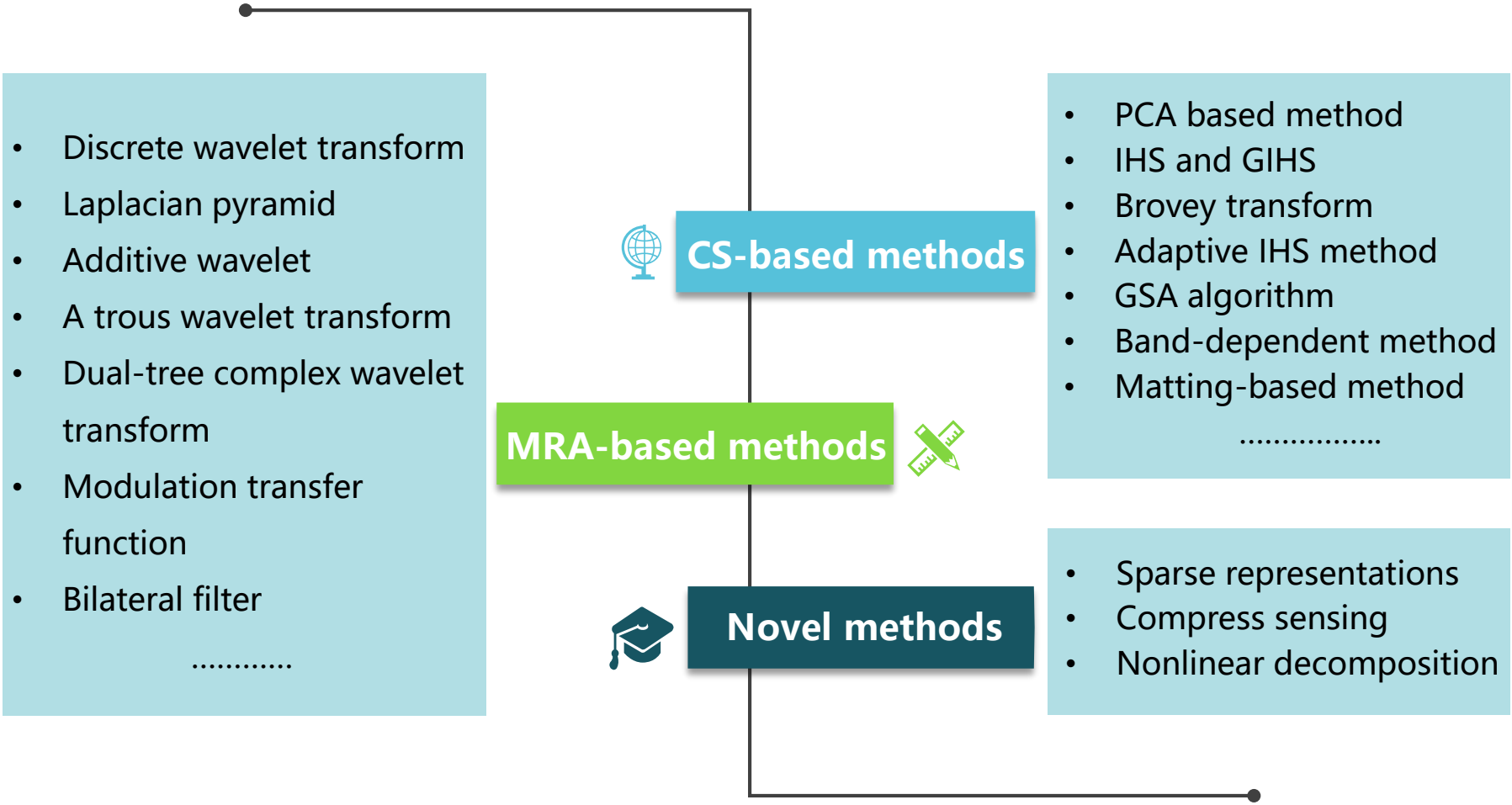
Multispectral Image

High spectral resolution

Fused Image

High spectral & spatial res.

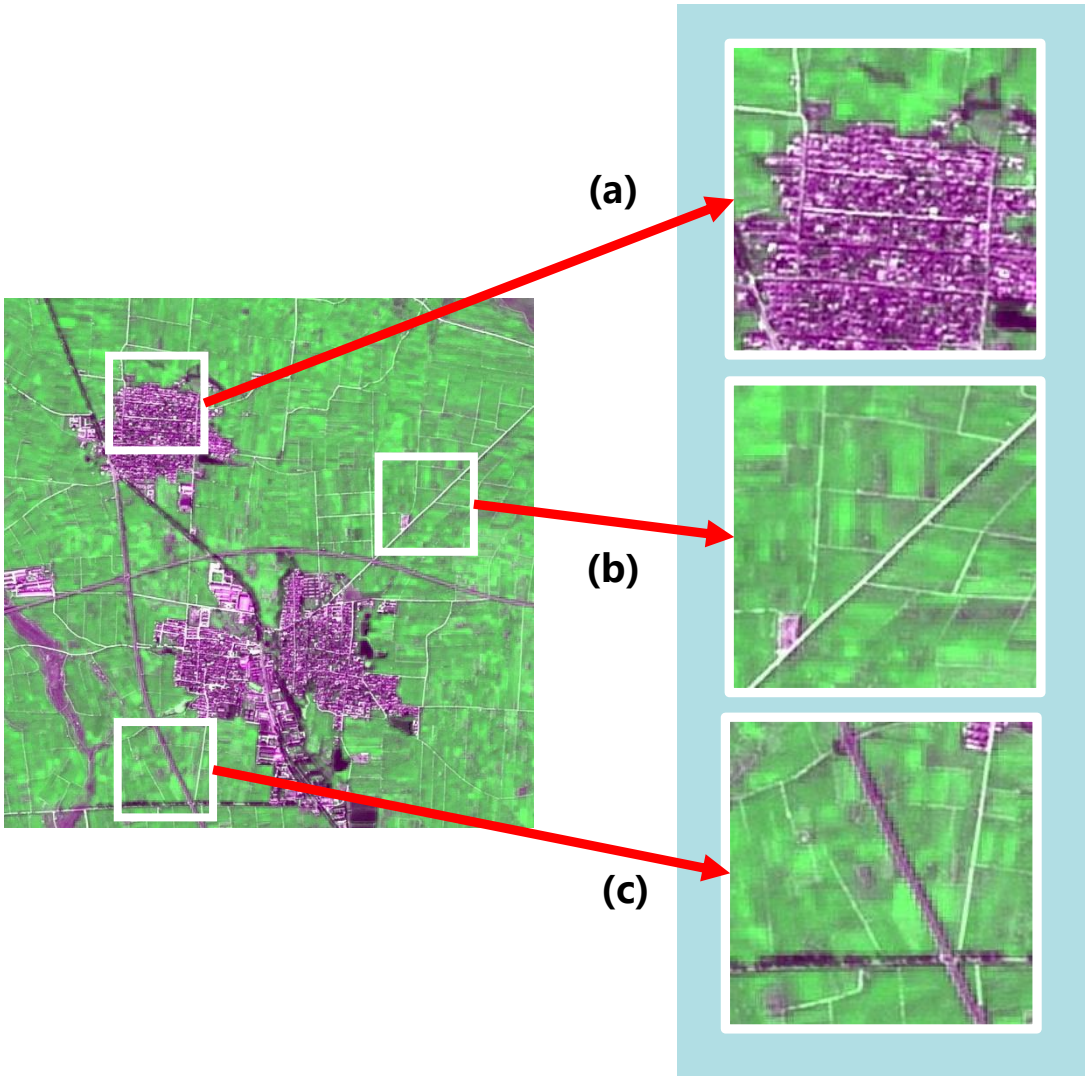
1.1 Background



1.2 Highlights

- Present a fusion method with special consideration of **different demands of different regions on spectral and spatial resolution**.
- Propose the **hybrid visual saliency analysis model** for indicating diverse needs of spatial and spectral resolution in remote sensing images.
- Propose **a sub-region strategy** for achieving better sub-region depictions.

1.3 Motivation



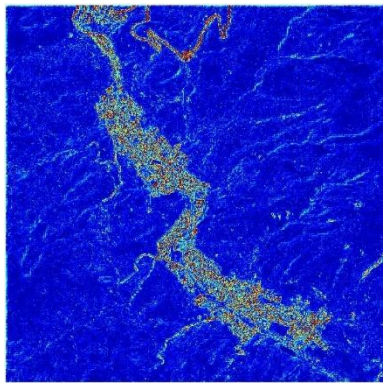
(a) (c) Residential Areas and Roads etc.

more **spatial details** for better visualization, analysis and classification

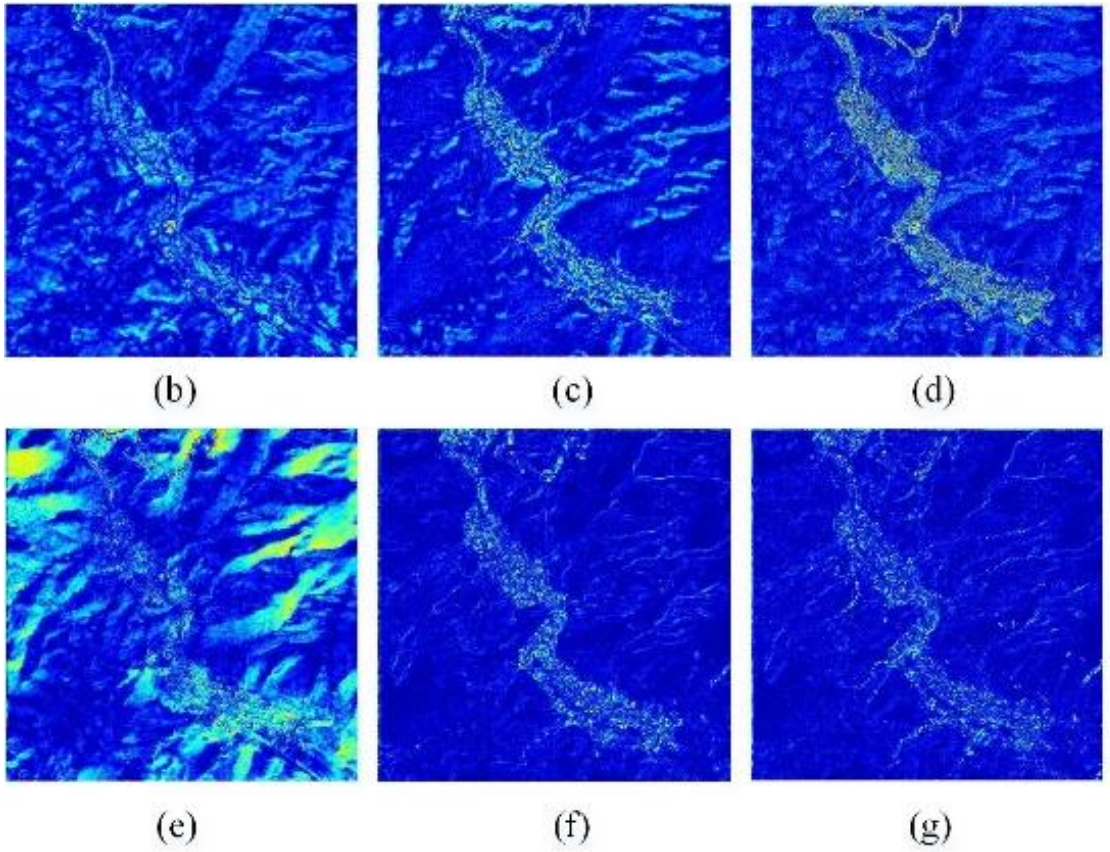
(b) Farmland and Forest

discriminated by **spectral characteristic**, thereby requiring **undistorted spectral features**

1.3 Motivation



(a)



(b) (c) (d)

(e) (f) (g)

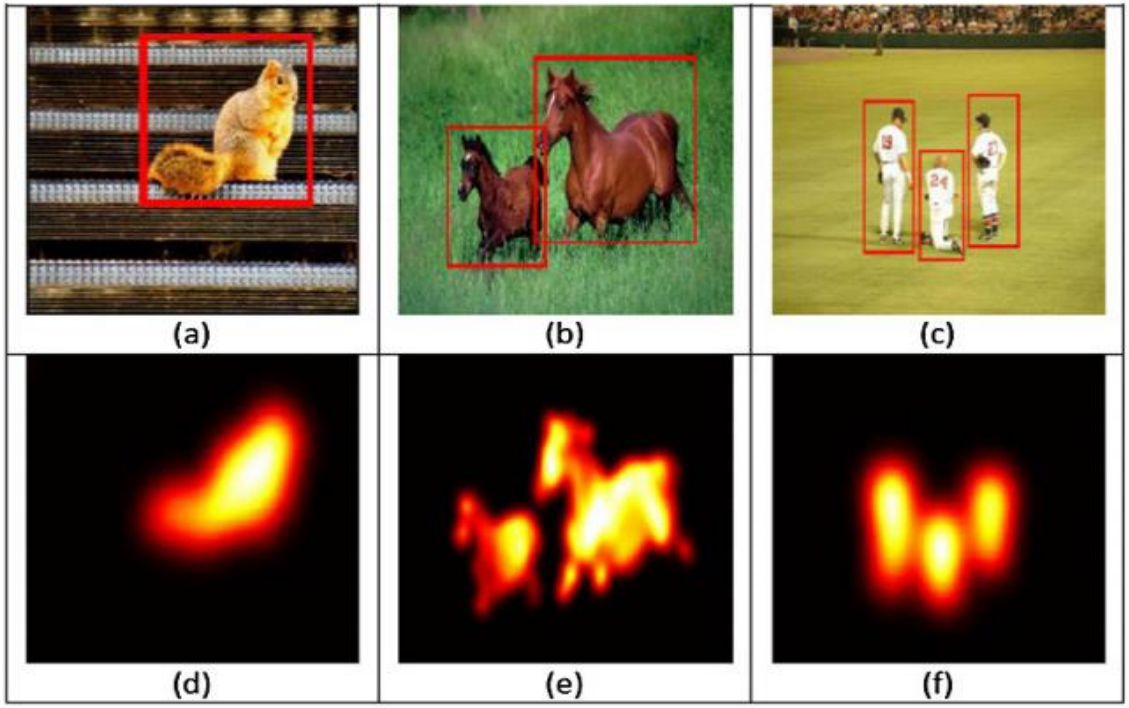
Difference images (blue means small differences, and red means large differences)

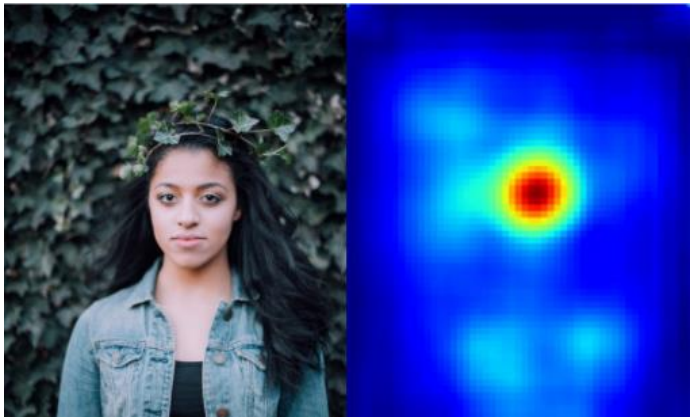
(a)Degraded MS image. (b)GIHS. (c)WT. (d)PCA. (e)MMGD. (f)RB-CWT. (g)OUR .

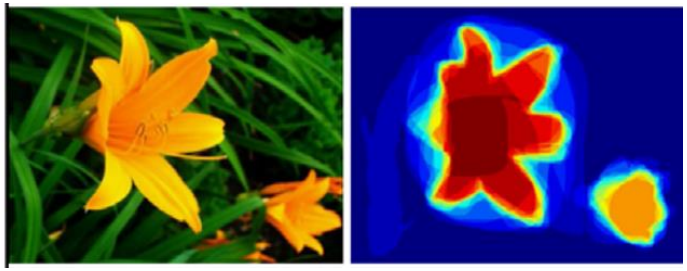
1.4 Saliency analysis

What is Saliency ?

- originates from research on **visual attention mechanism**
- extract **unique parts** that can draw people’ s immediate attention in images







2 Methodology

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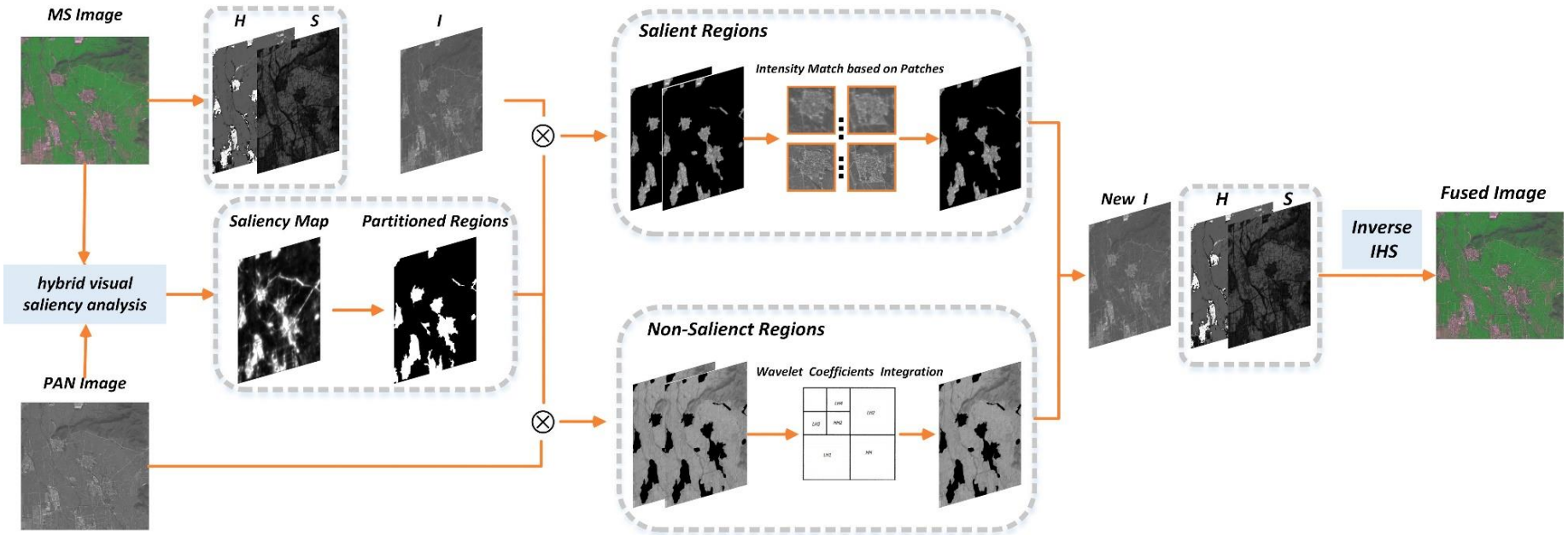


- makes it possible to **do a trade-off between the improvement of spatial quality and spectral maintenance in different regions**.
- our proposal is expected to be more suitable for the follow-up analysis like **cover-up classification and object detection.**

2.1 Salient Region Extraction

Hybrid Visual Saliency Analysis Model

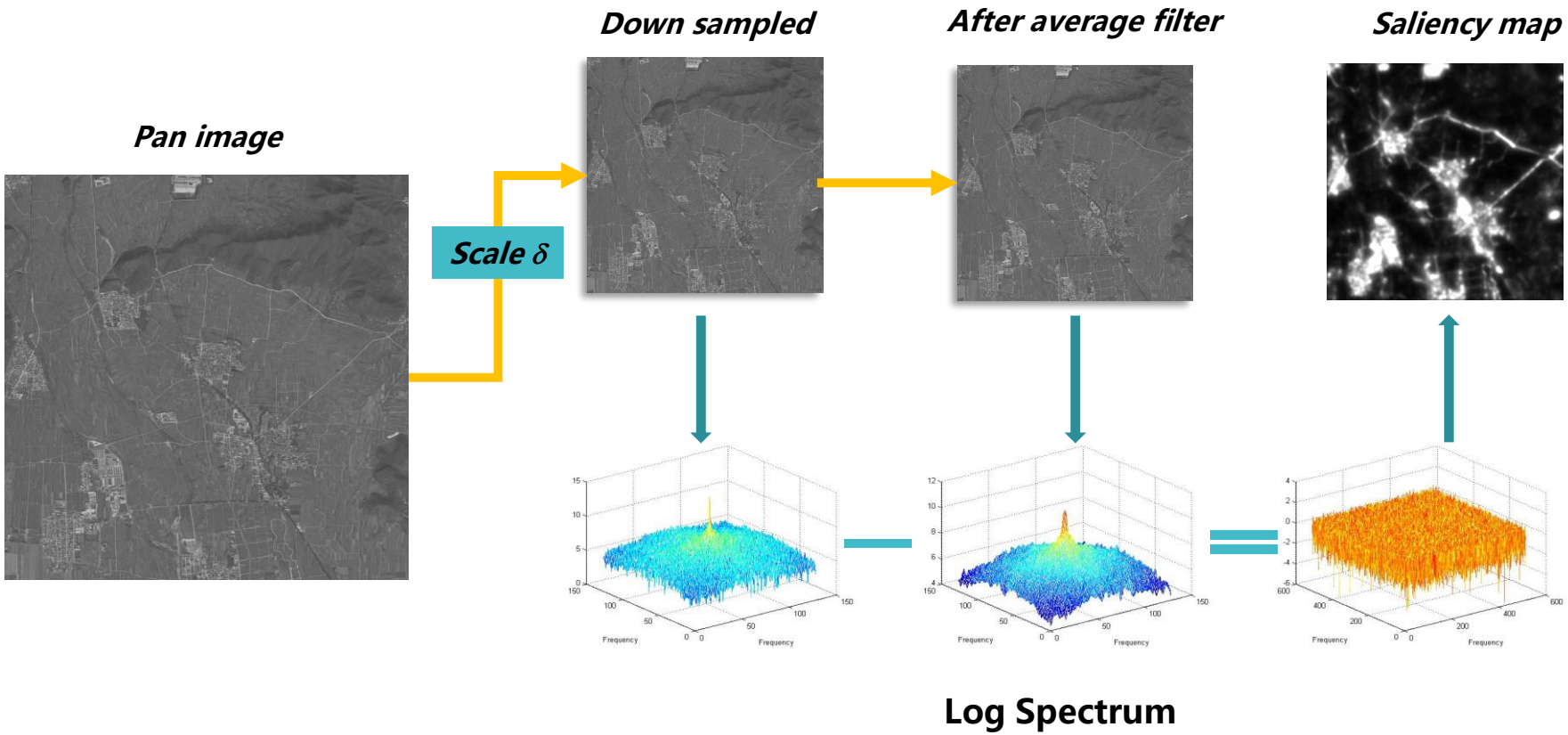
In our design:

- ✓ **spatial feature** (PAN image) + **spectral feature** (MS images) for fetching the saliency
- ✓ **salient regions** needing more spatial details (**e.g. residential areas and roads**) **non-salient regions** requiring undistorted spectral feature (**e.g. grassland and forest**)

- ***Intensity feature extraction***
- ***Color feature extraction***
- ***The generation of the saliency map***

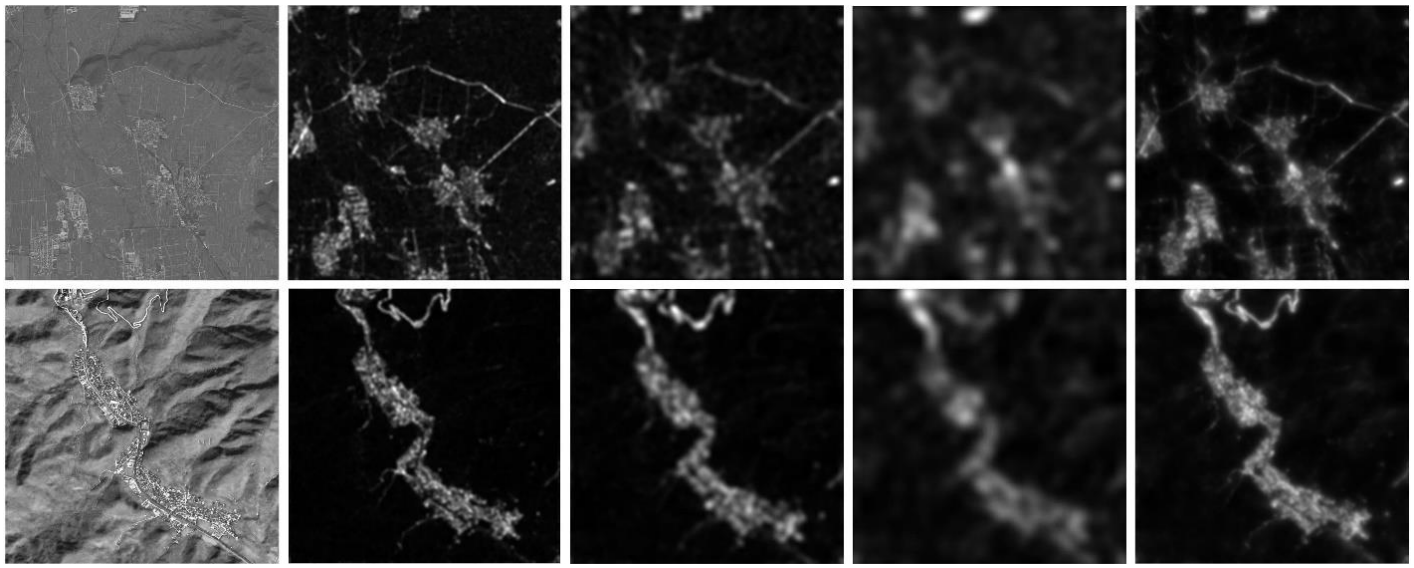
2.1 Salient Region Extraction

- ***Intensity feature extraction***



2.1 Salient Region Extraction

- ***Intensity feature extraction***



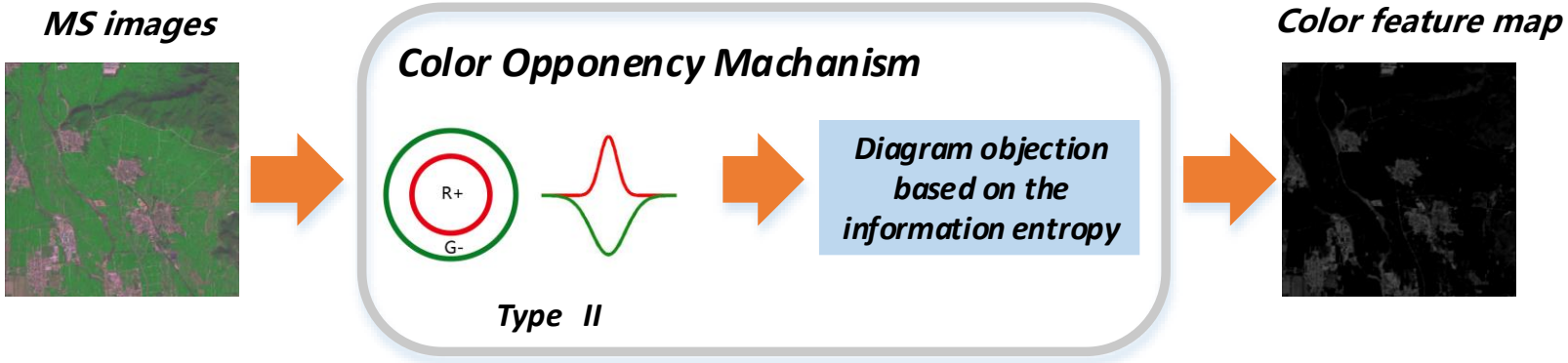
(a) (b) (c) (d) (e)

Intensity feature maps based on the multi-scale frequency analysis strategy

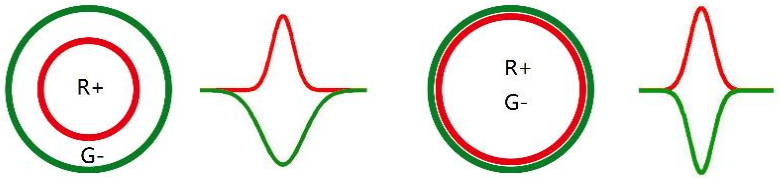
(a) Pan images ***scale:*** *(b) 256×256 (c) 128×128 (d) 64×64 (e) Multi-scale*

2.1 Salient Region Extraction

- ***Color feature extraction***



Receptive Fields



Type I Type II

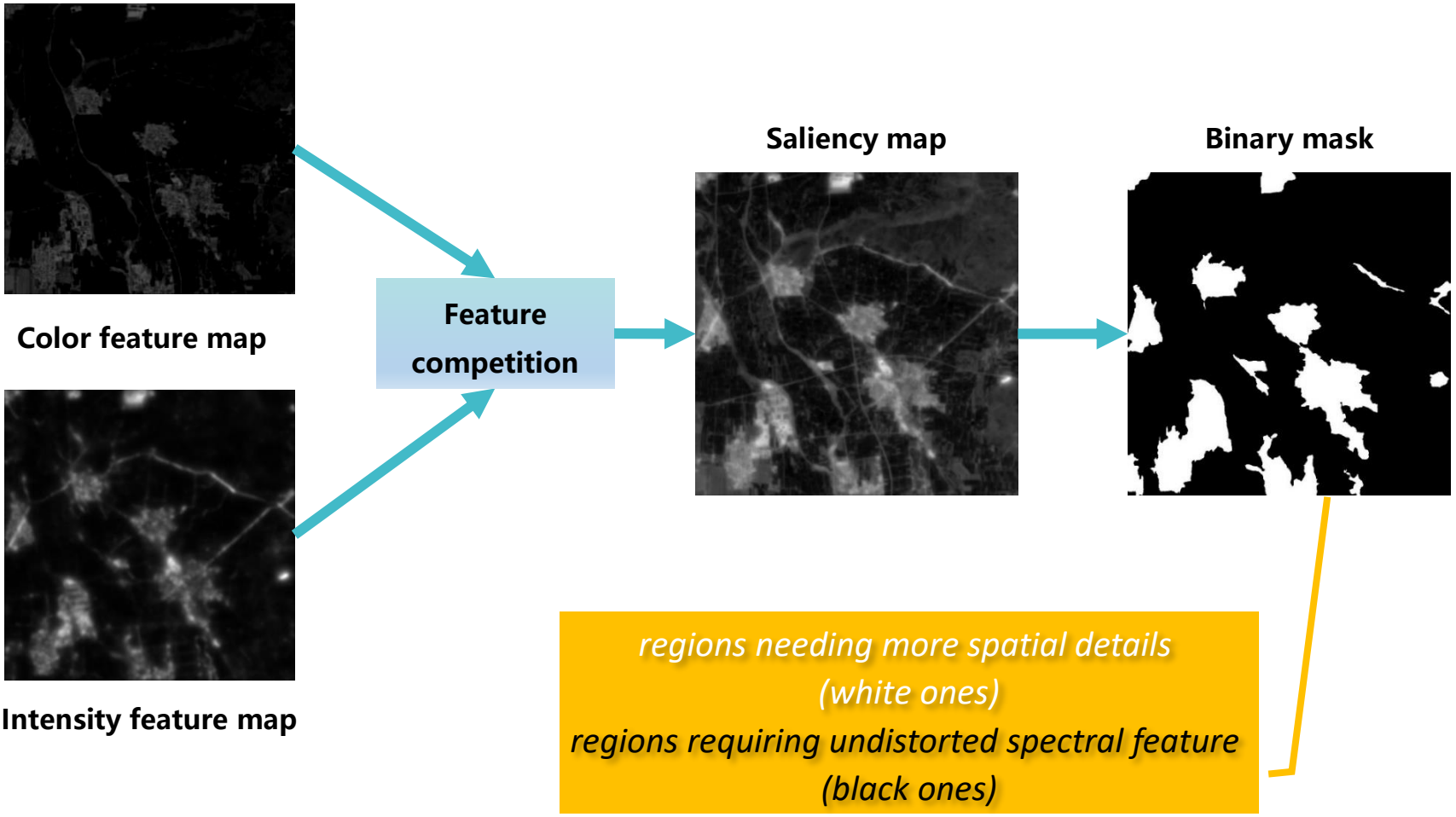
Diagram objection

$$H(k) = -\frac{l_k}{M}\sum_{i=1}^{k}\log\frac{l_k}{M}$$

$$\tilde{C}(x,y) = H(k) \quad as \quad \tilde{O}(x,y) = k$$

2.1 Salient Region Extraction

- ***Generation of saliency maps: weighted combination via feature competition***



2.2 Sub-region Fusion Strategy

- ***Fusion Approach for salient regions***

Goal : improve the **spatial resolution** as much as possible and simultaneously reduce the spectral distortion to a certain extent

Method : windowed IHS

$$T = Q_W \times \frac{\overline{P}_W}{\overline{Q}_W}$$

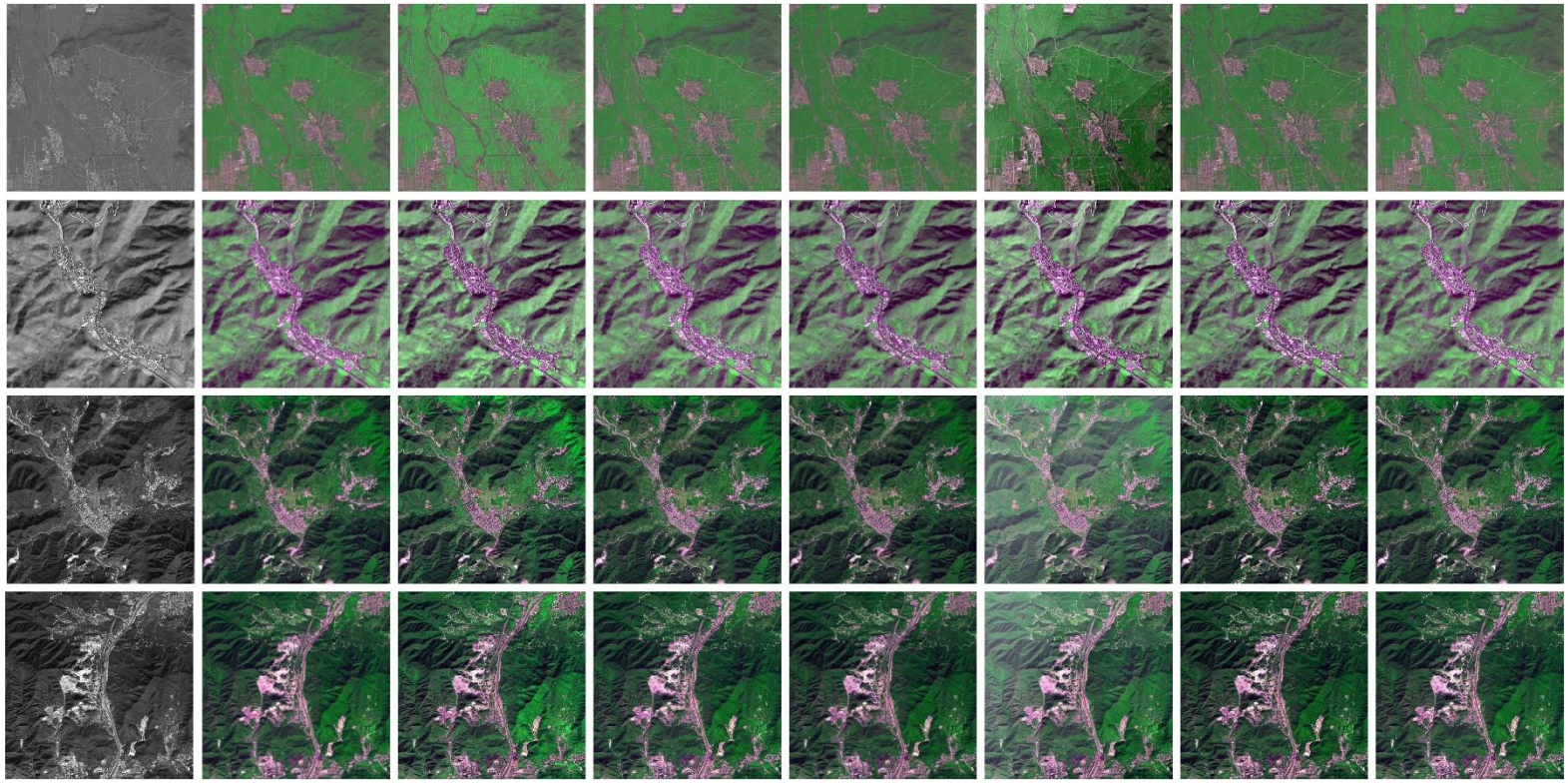
- ***Fusion Approach for non-salient regions***

Goal : give priority to **spectral maintenance**

Method : multiresolution analysis based on DWT

3 Experiments

3.1 Visual comparison

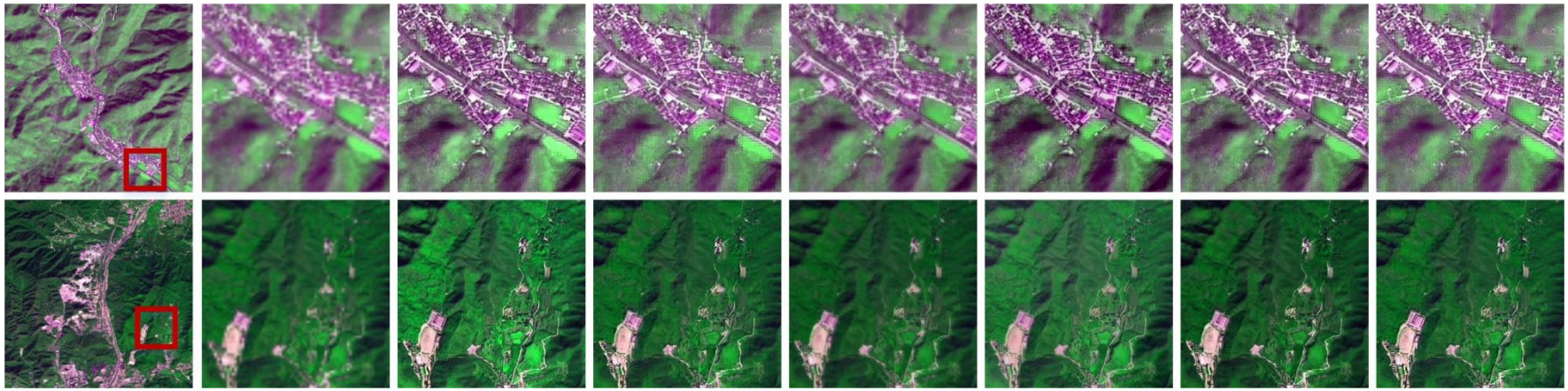


(a) (b) (c) (d) (e) (f) (g) (h)

(a) PAN images (b) Degraded MS images; (c) IHS (d) WT (e) PCA (f) MMGD (g) RB-CWT (h) Our Proposal

3.1 Visual comparison

- ***zoomed views***



(a) (b) (c) (d) (e) (f) (g)

(a) Degraded MS images (b) IHS (c) WT (d) PCA (e) MMGD (f) RB-CWT (g) Our method

3.2 Quantitative Assessment

Quantitative evaluation of the whole image

Methods	AG	DC	RASE	ERGAS
IHS	5.225	0.124	11.132	4.781
PCA	2.644	0.069	2.480	1.211
MMGD	7.998	0.242	6.984	3.153
RB-CWT	4.491	0.086	1.737	0.902
WT	4.686	0.047	4.054	1.886
Our	**4.847**	**0.041**	**4.012**	**1.876**

3.2 Quantitative Assessment

Quantitative evaluation of non-salient regions

Methods	AG	DC	RASE	ERGAS
IHS	3.921	0.124	14.797	6.139
WT	3.457	0.037	5.534	2.596
PCA	2.041	0.069	9.878	4.233
MMGD	6.105	0.241	25.613	11.549
RB-CWT	3.265	0.082	9.8880	4.190
Our	**3.441**	**0.029**	**5.932**	**2.798**

Quantitative evaluation of salient regions

Methods	AG	DC	RASE	ERGAS
IHS	13.375	0.125	7.654	3.457
WT	12.368	0.106	8.877	4.307
PCA	6.408	0.068	13.860	6.525
MMGD	19.818	0.247	23.825	10.733
RB-CWT	12.157	0.114	10.057	4.805
Our	**13.639**	**0.114**	**7.947**	**3.950**

4 Future Work

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Thank You