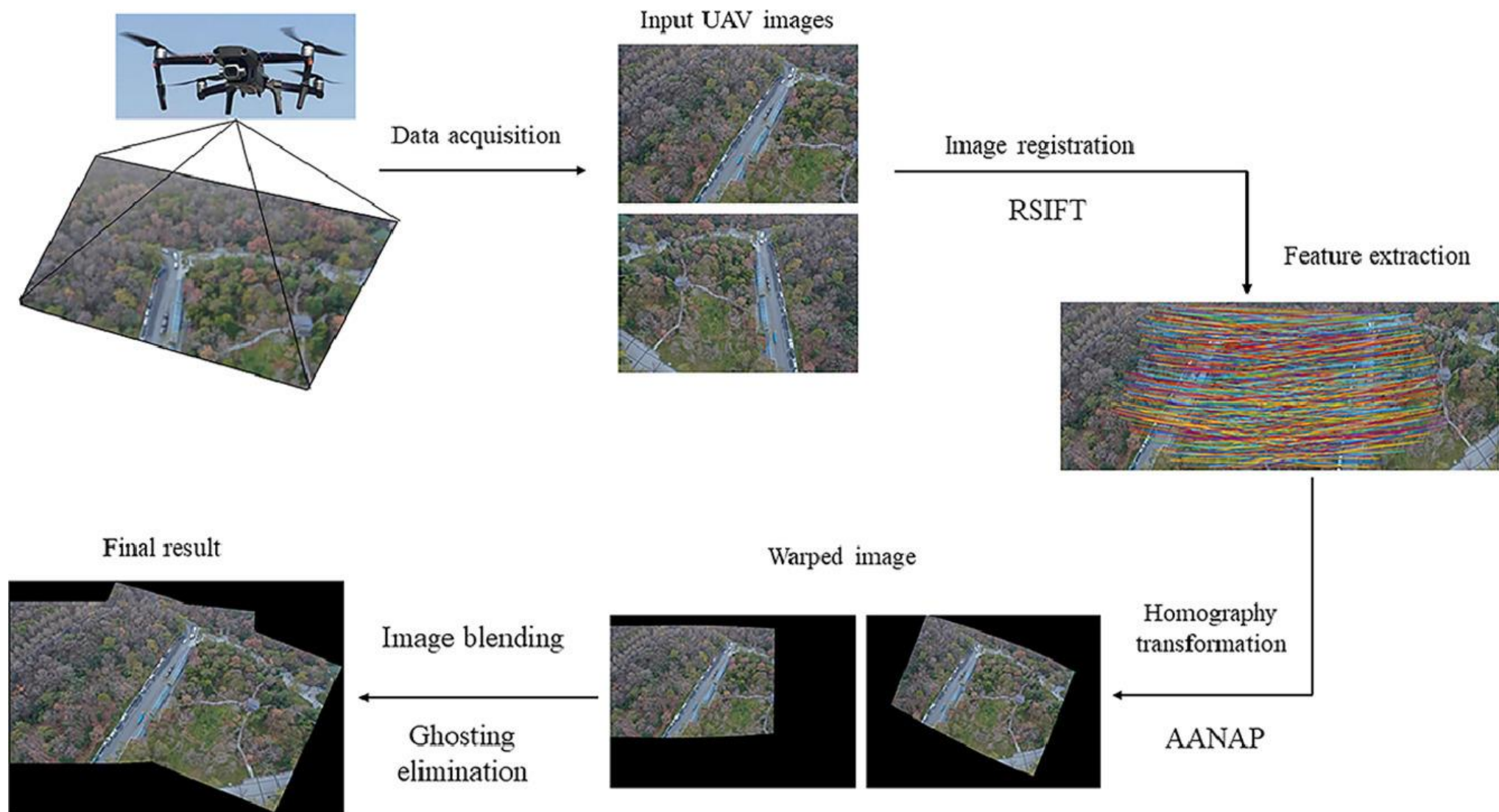
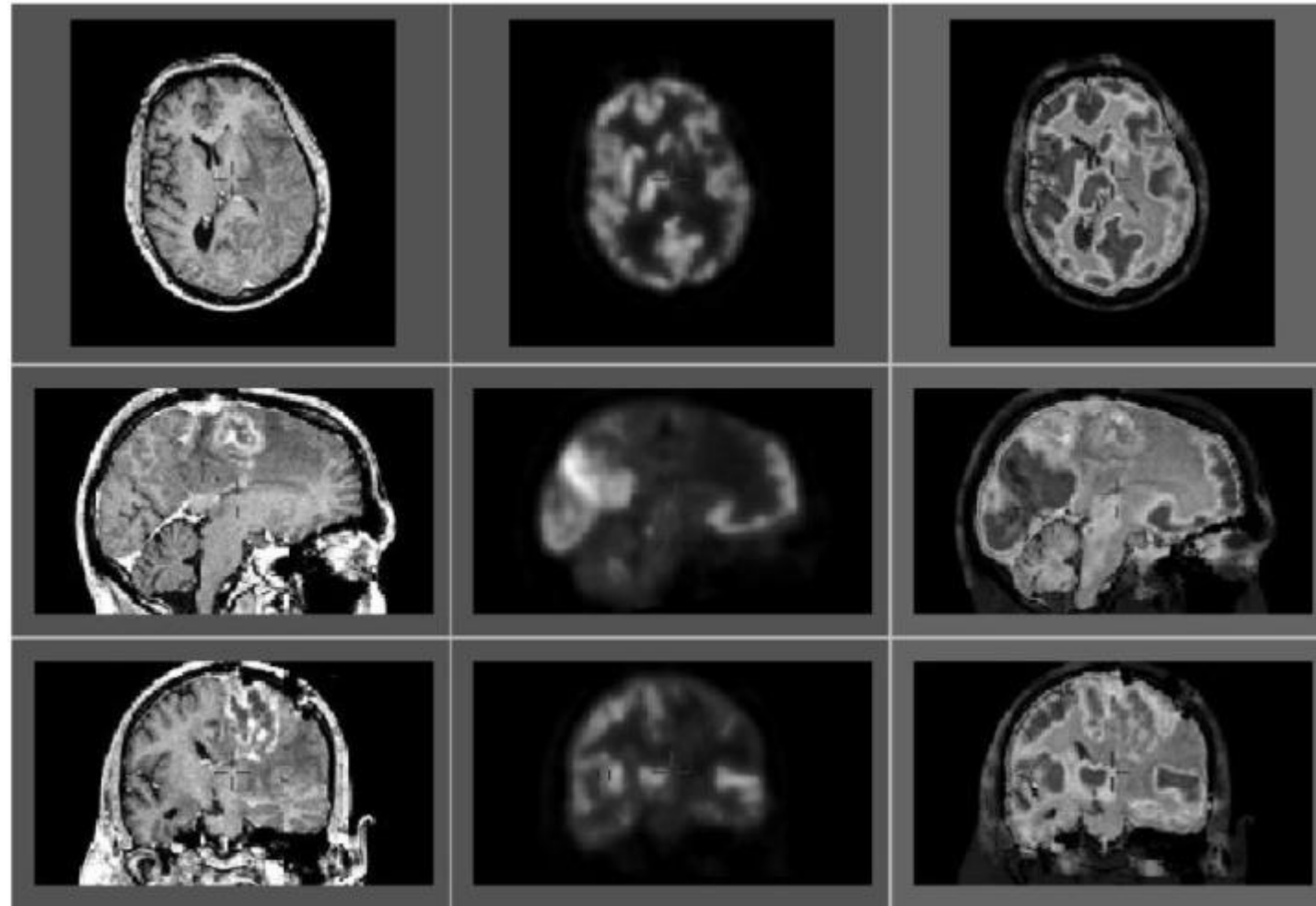


图像配准、拼接、融合

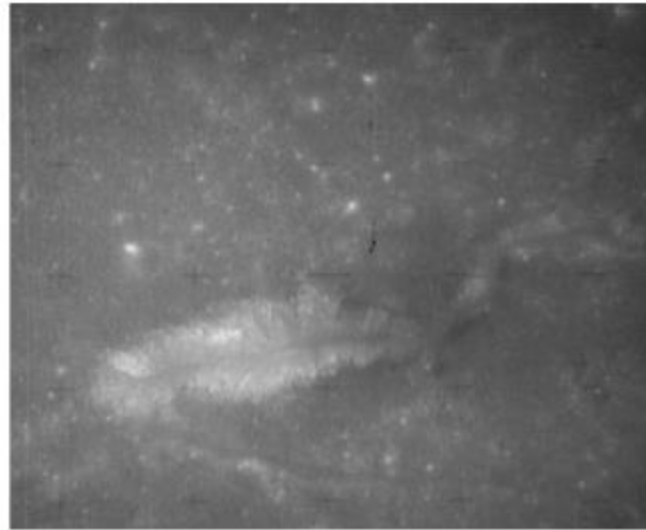
Image Registration, Mosaicing, Fusion



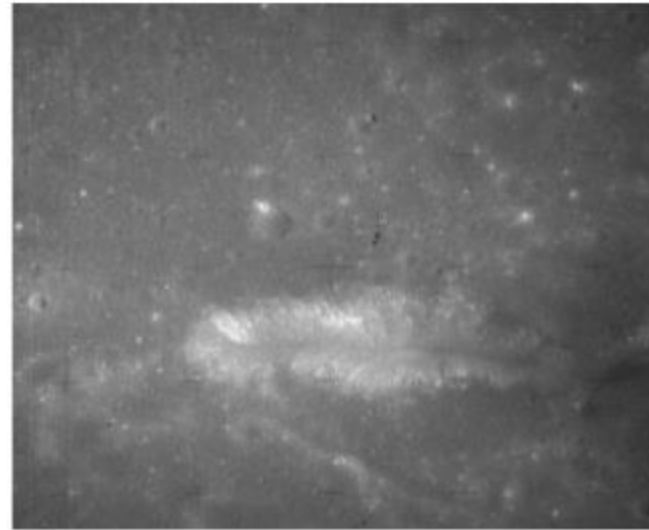


Registration of MR and PET images of the same person.

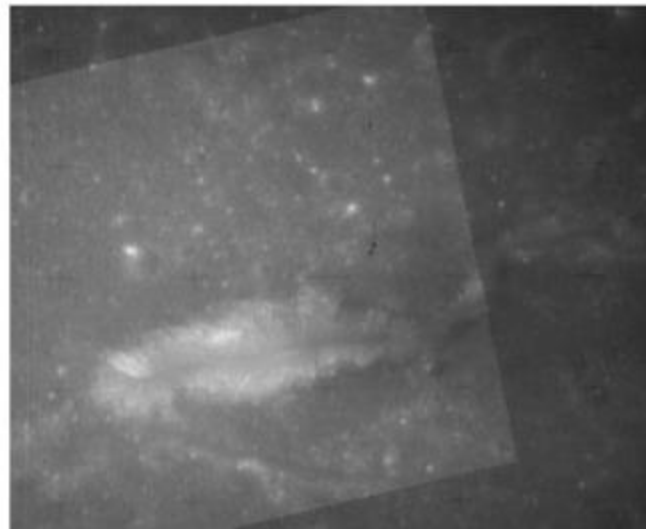
Lunar  
image 1.



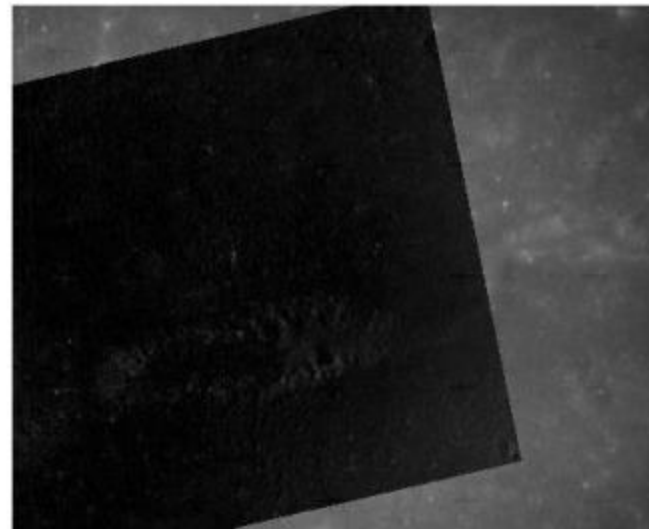
Lunar  
image 2.

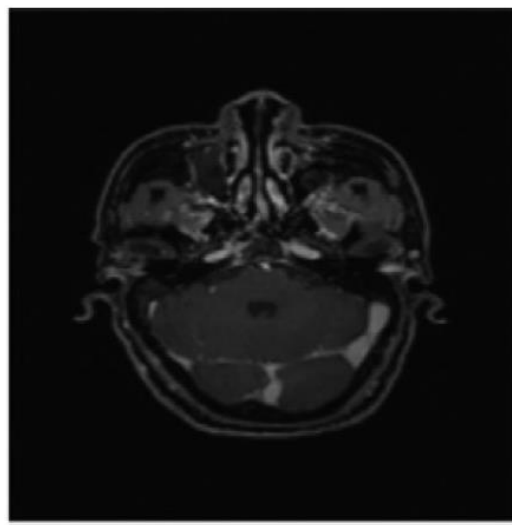
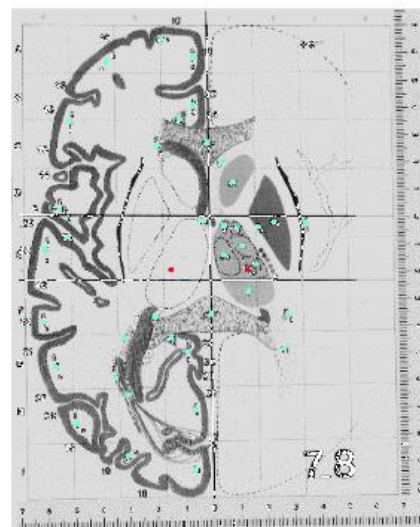
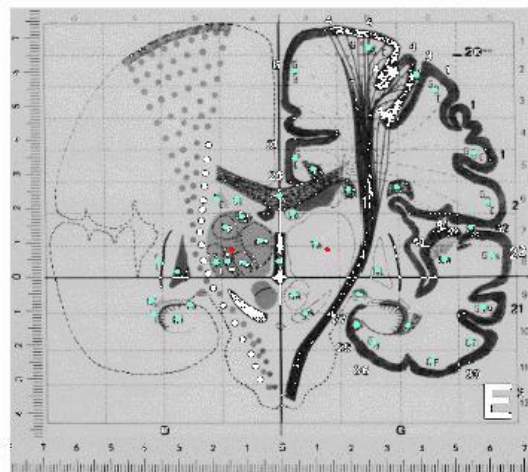
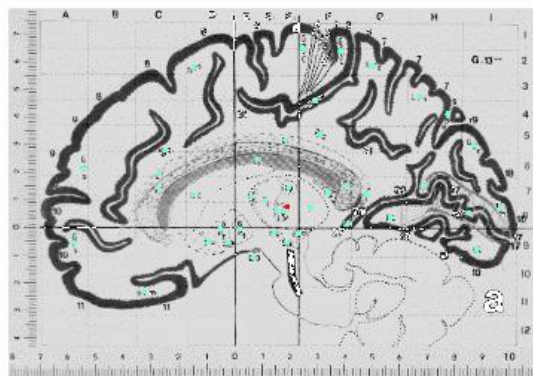


Registered  
lunar  
images.

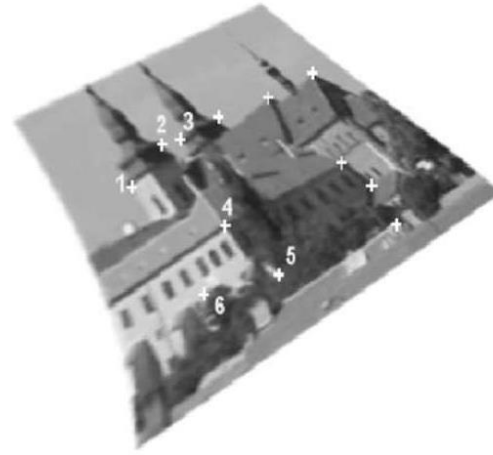
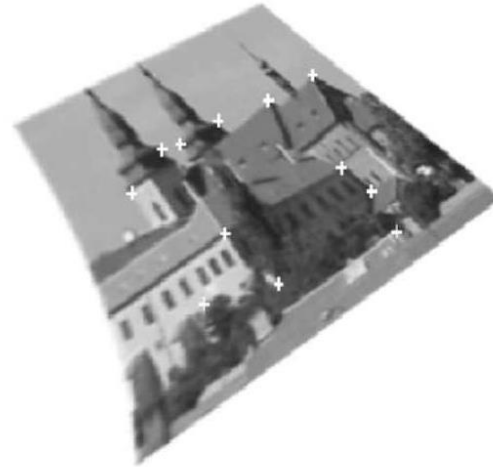


Subtracted  
images  
after  
registration.

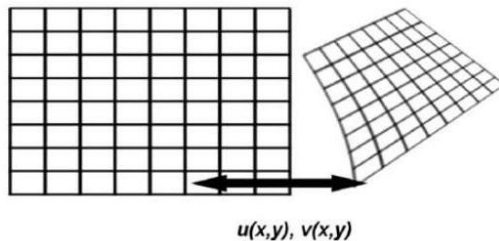




## 图像配准主要步骤



1. 特征提取  
area based, feature based
2. 特征匹配  
area based : correlation-like methods
3. 坐标映射  
浮动图坐标映射到参考图坐标
4. 图像几何变换  
图像变换到相同坐标系





# Geometric Transform Models

## Global mapping models

Bivariate polynomials of low degrees

$$u = \sum_{i=0}^N \sum_{j=0}^N a_{ij} x^i y^j$$
$$v = \sum_{i=0}^N \sum_{j=0}^N b_{ij} x^i y^j$$

仿射变换(affine transform)

$$\begin{pmatrix} u \\ v \end{pmatrix} = \begin{pmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{pmatrix} \begin{pmatrix} x \\ y \\ 1 \end{pmatrix}$$

# 特征匹配 (Feature Matching)

## Area based methods :

### Correlation-like methods

$$NCC(u) = \frac{\sum_i [I_1(x_i) - \bar{I}_1][I_2(x_i + u) - \bar{I}_2]}{\sqrt{\sum_i [I_1(x_i) - \bar{I}_1]^2 [I_2(x_i + u) - \bar{I}_2]^2}}$$

$$\bar{I}_1 = \frac{1}{N} \sum_i I_1(x_i)$$
$$\bar{I}_2 = \frac{1}{N} \sum_i I_2(x_i + u)$$

### Mutual Information methods

$$MI(I_1, I_2) = E(I_1) + E(I_2) - E(I_1, I_2)$$

$$E(I_1) = -\sum_g p_{I_1}(g) \log(p_{I_1}(g))$$

$$E(I_1, I_2) = -\sum_{g,h} p_{I_1, I_2}(g, h) \log(p_{I_1, I_2}(g, h))$$

## Feature based methods

### Harris corner detector

$$C = \sum_i w(x_i, y_i) \begin{bmatrix} I_{x_i}^2 & I_{x_i} I_{y_i} \\ I_{x_i} I_{y_i} & I_{y_i}^2 \end{bmatrix}$$

$$R = \text{Det}(C) - \alpha \text{Tr}^2(C)$$

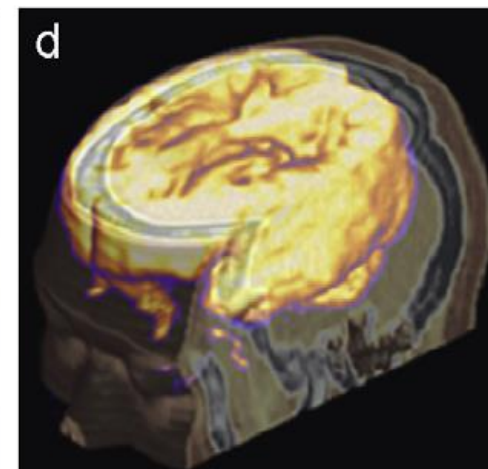
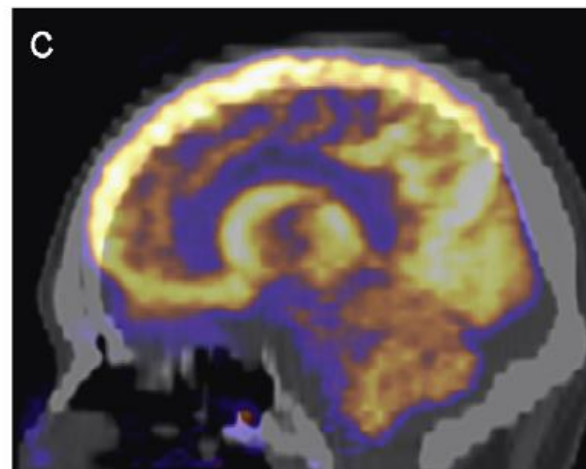
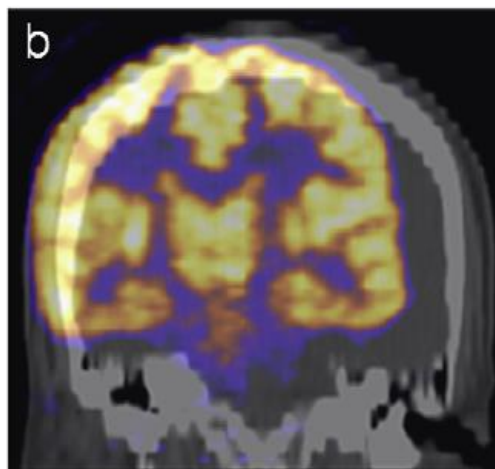
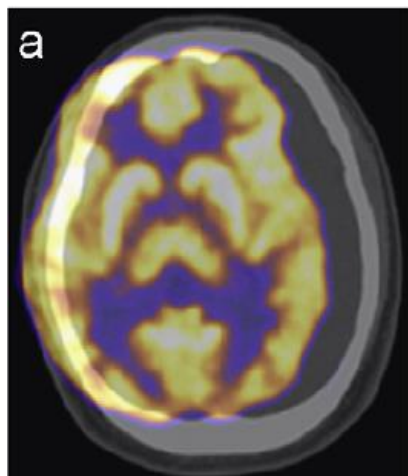
$$0.04 \leq \alpha \leq 0.06$$

### Graph matching Algorithm

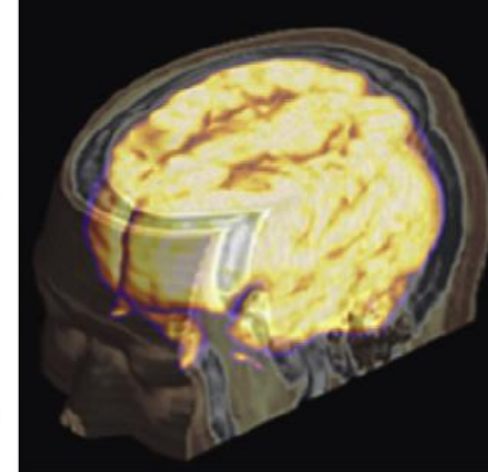
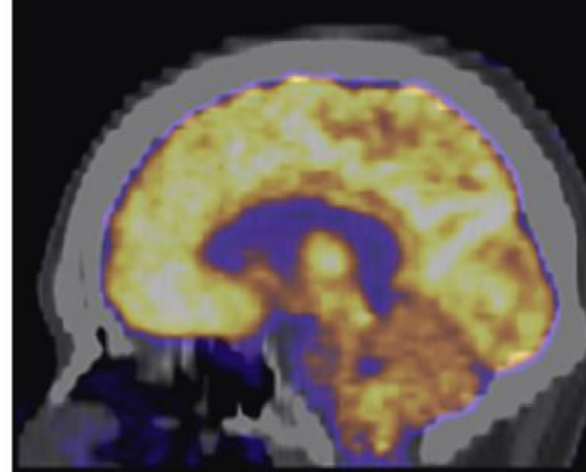
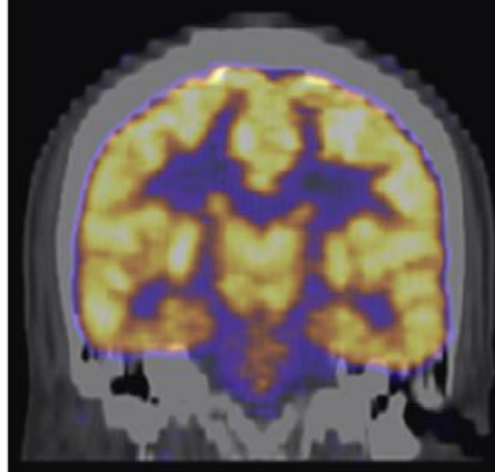
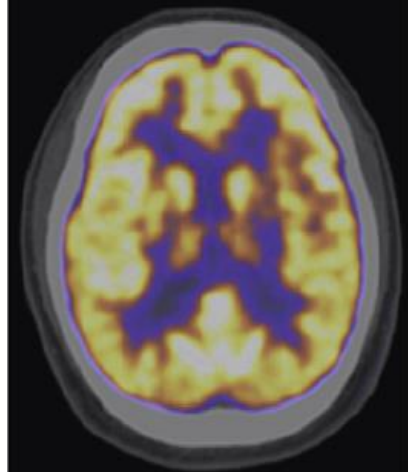


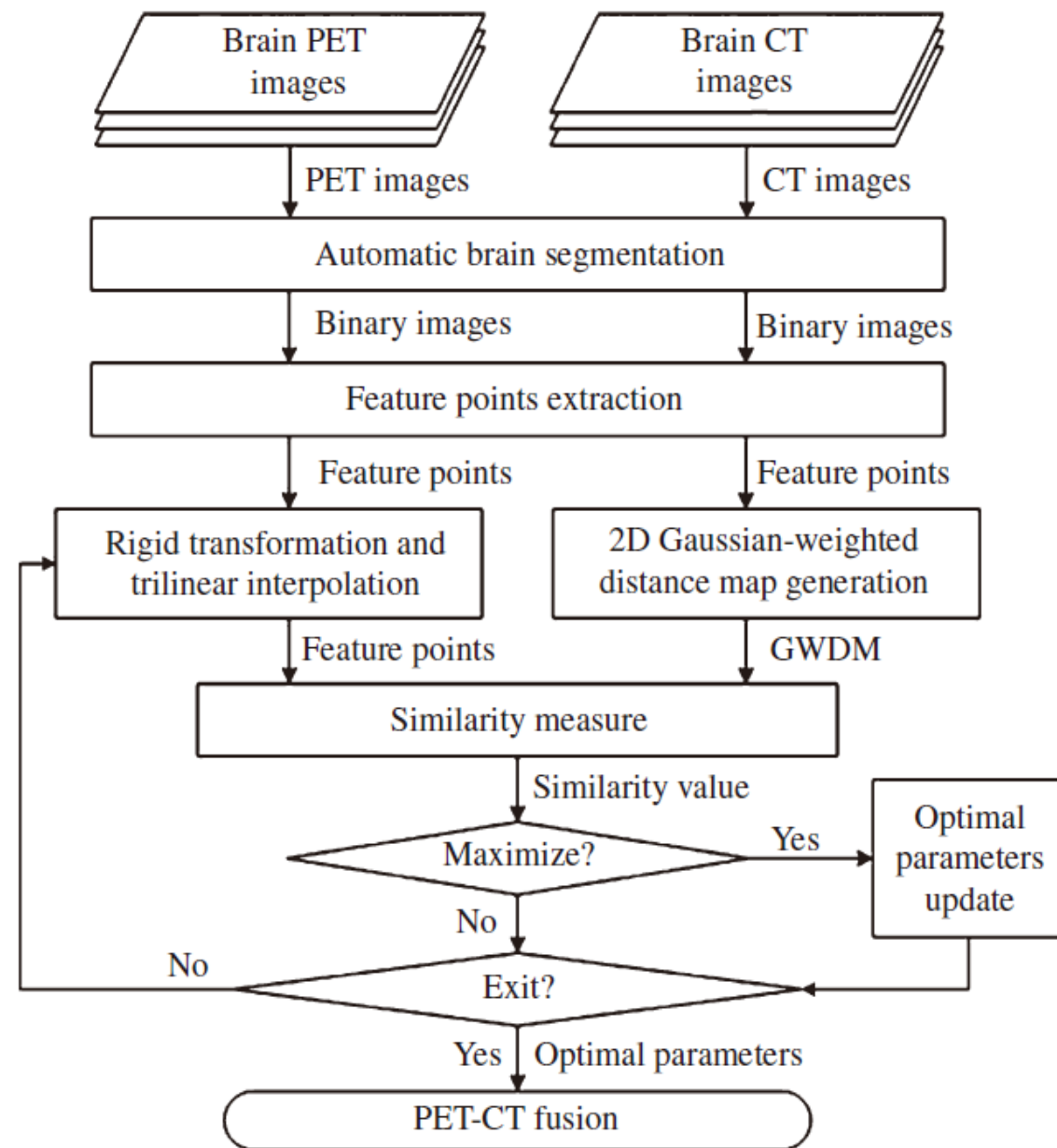
H. Lee, J. Lee, *et al*, Robust feature-based registration using a Gaussian-weighted distance map and brain feature points for brain PET/CT images, Computers in Biology and Medicine 38 (2008) 945–961

配准前

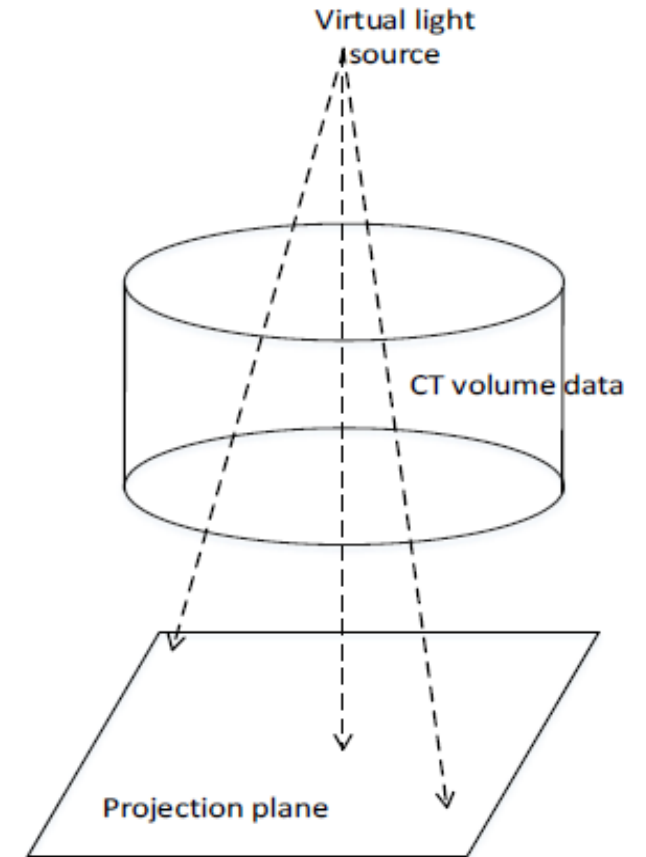
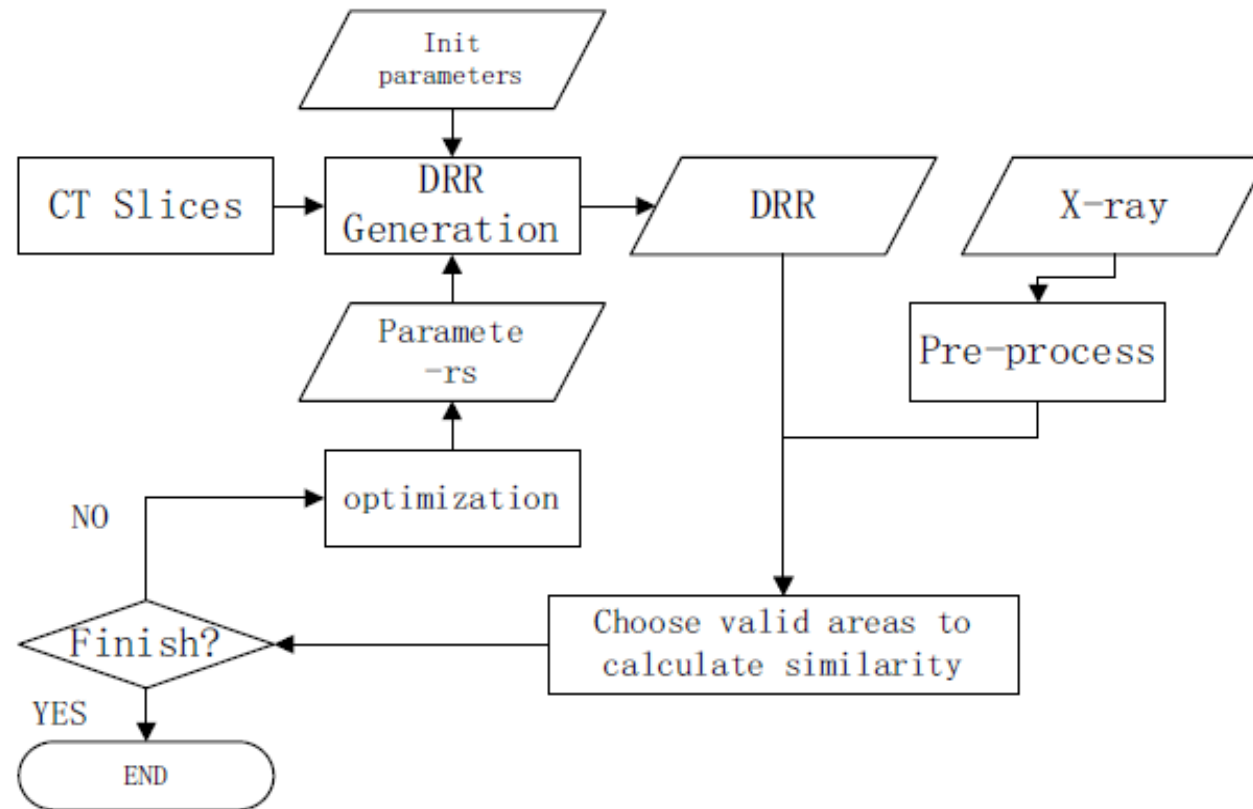


配准后



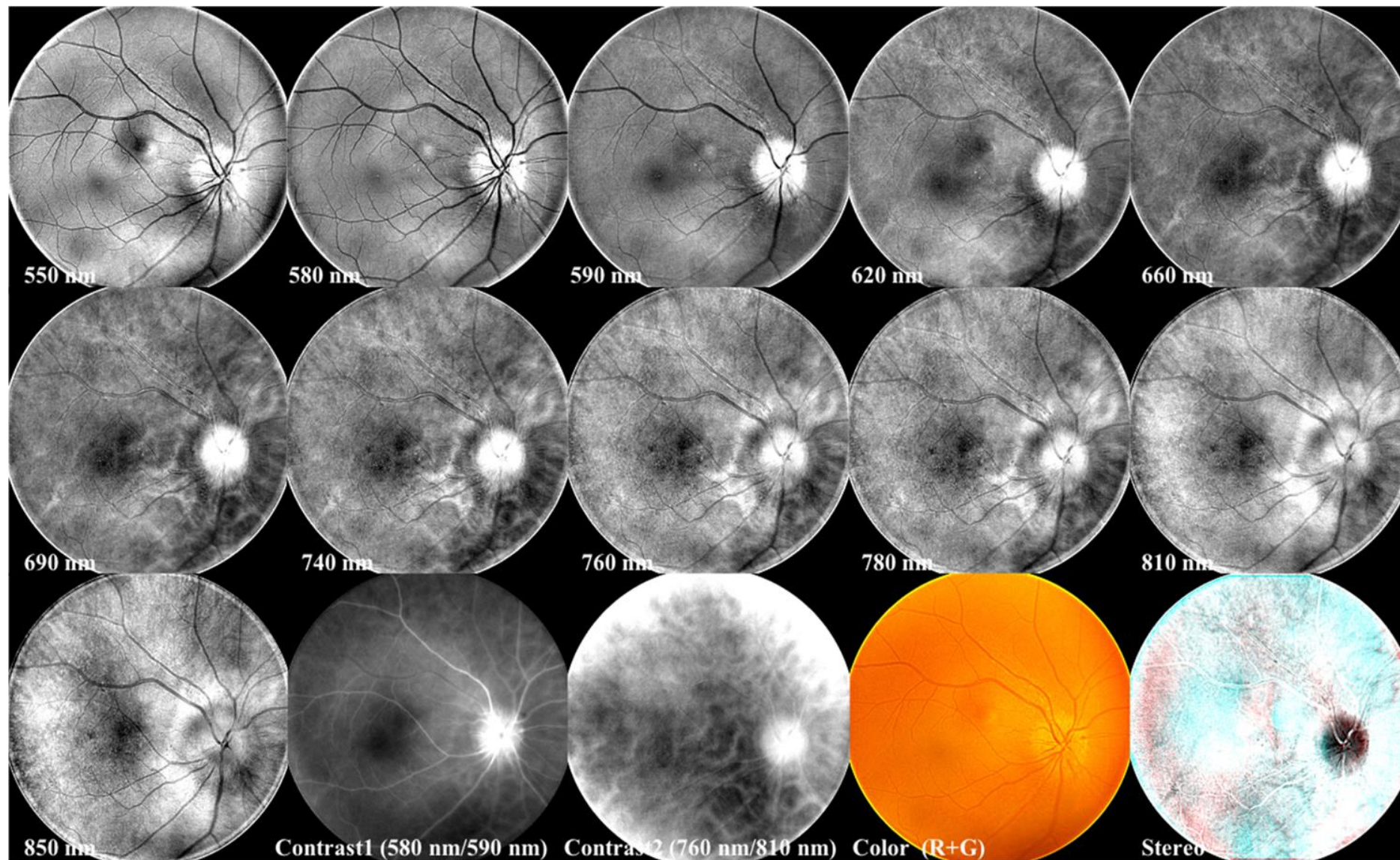


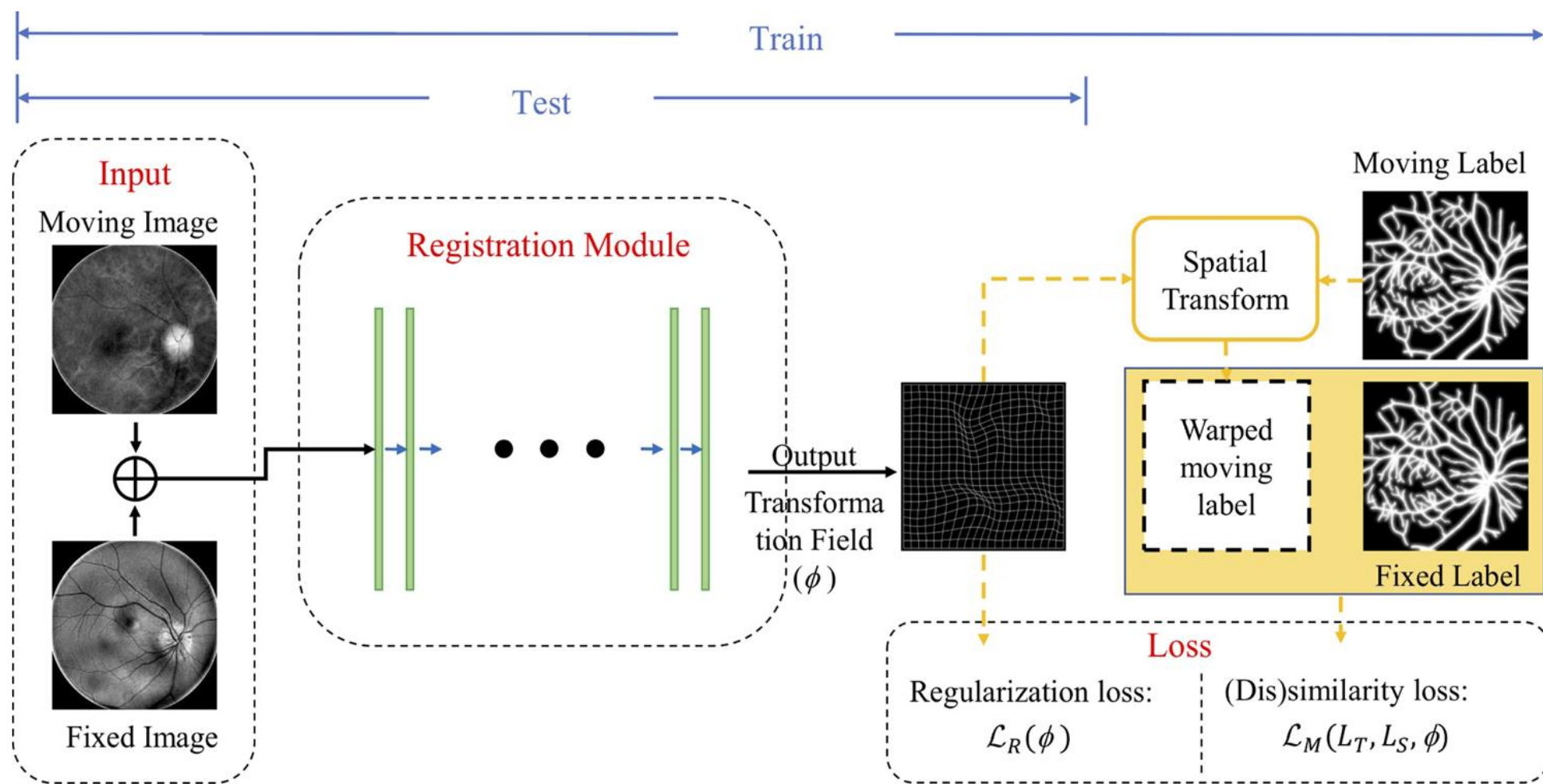
H. Pan, C. Zhou, *et al*, A Fast Registration from 3D CT Images to 2D X-ray Images, Proc. IEEE 3rd International Conference on Big Data Analysis, 2018, pp 351-355

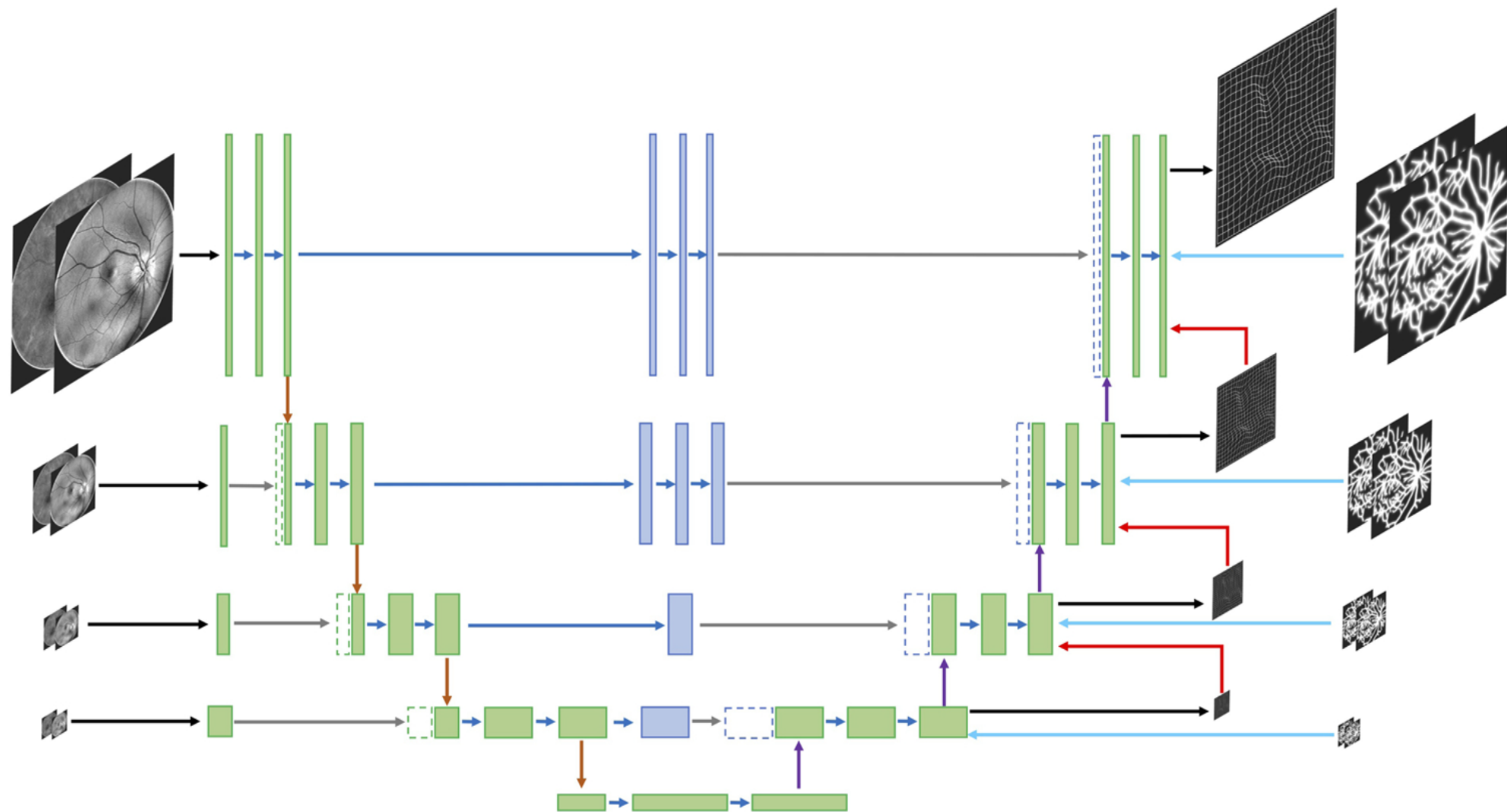




X. Sui , Y. Zheng , et al, Deep multispectral image registration network, Computerized Medical Imaging and Graphics, (87) 2021







→ Input and output

→ Copy

↓ Pooling

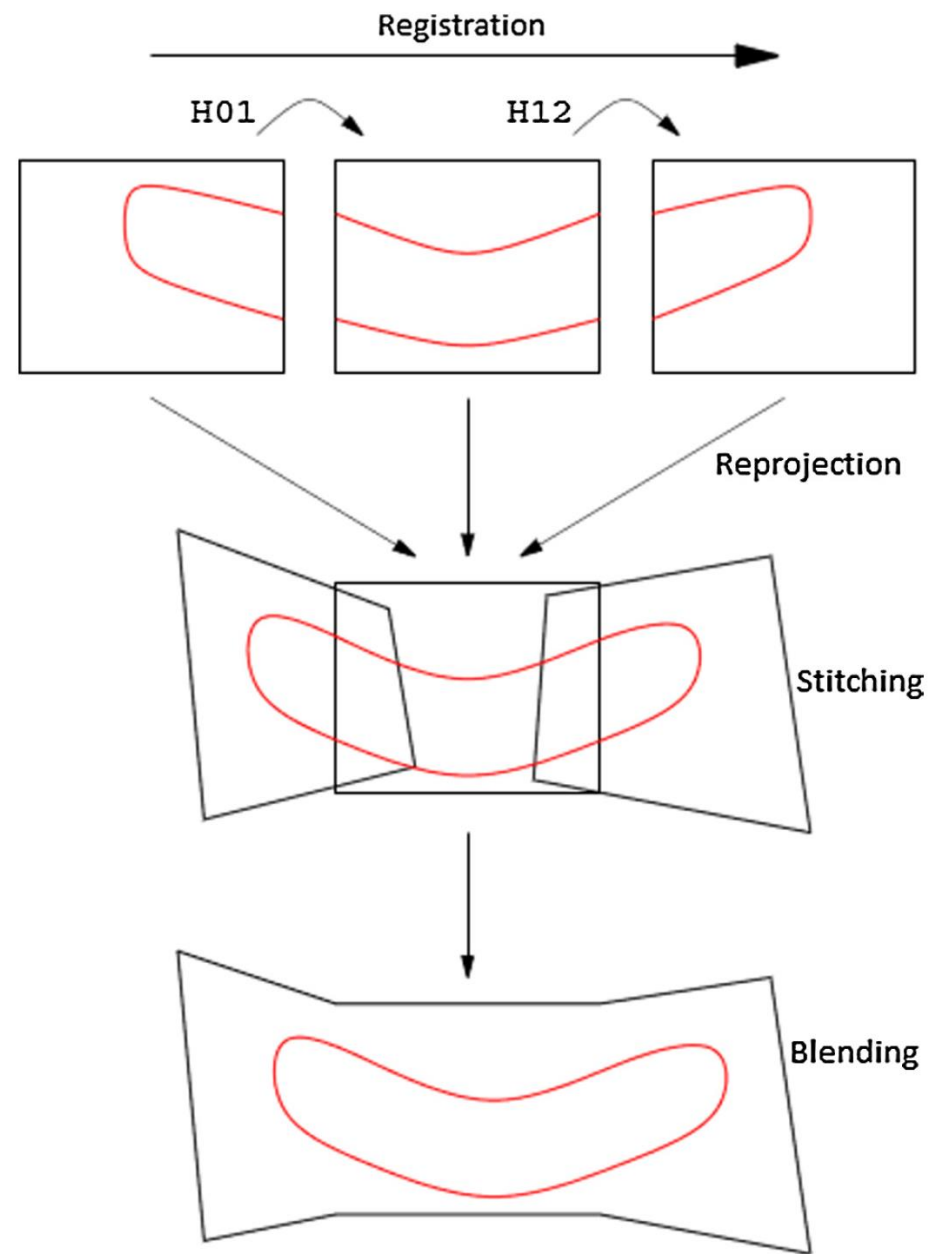
↖ Interpolate

→ Conv + ReLU

→ (Dis)similarity loss

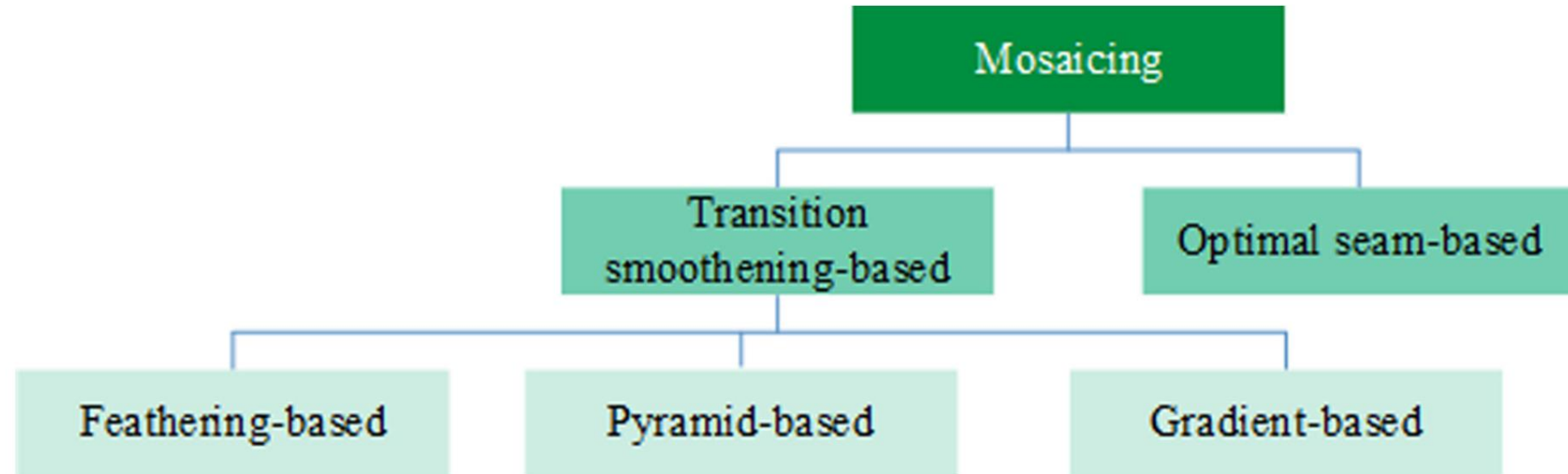
↑ Deconvolution

# 图像拼接 (Image Mosaicing)

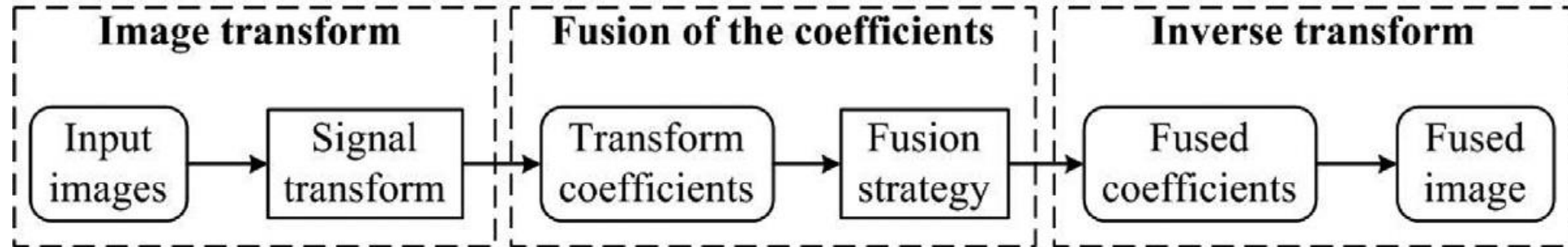




## Image Blending



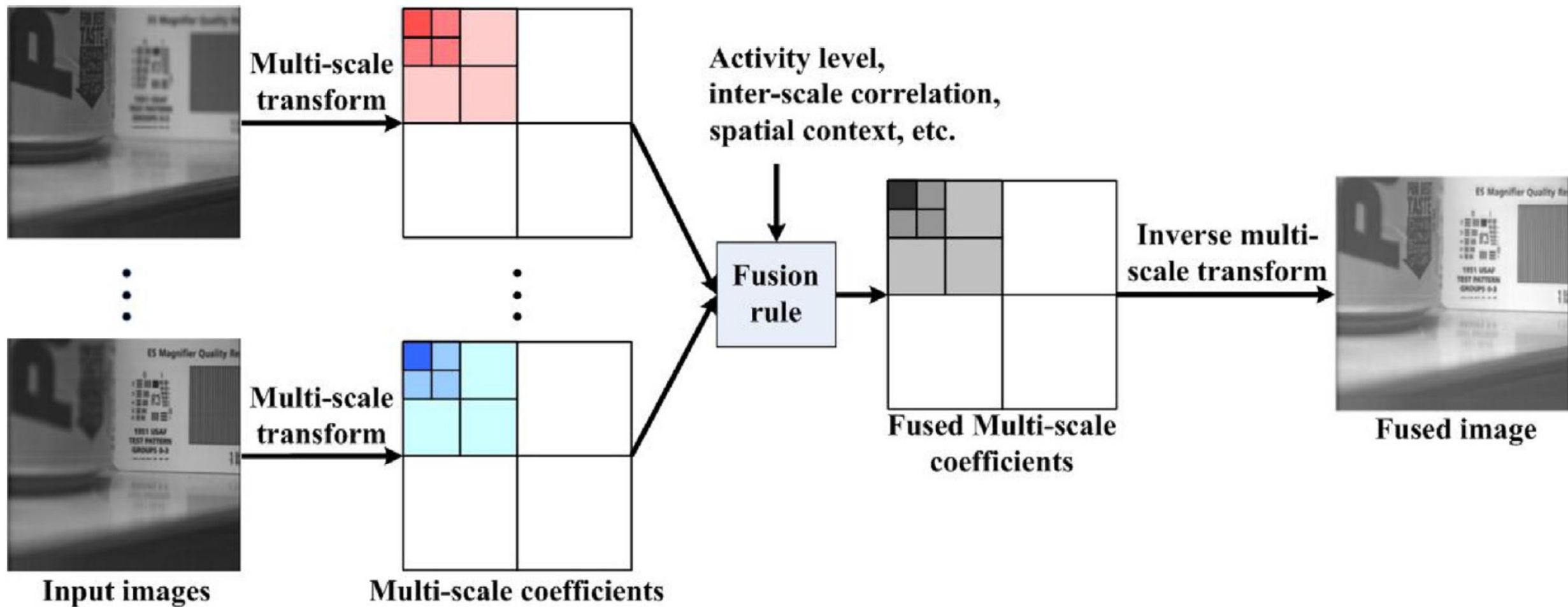
## Pixel based image fusion



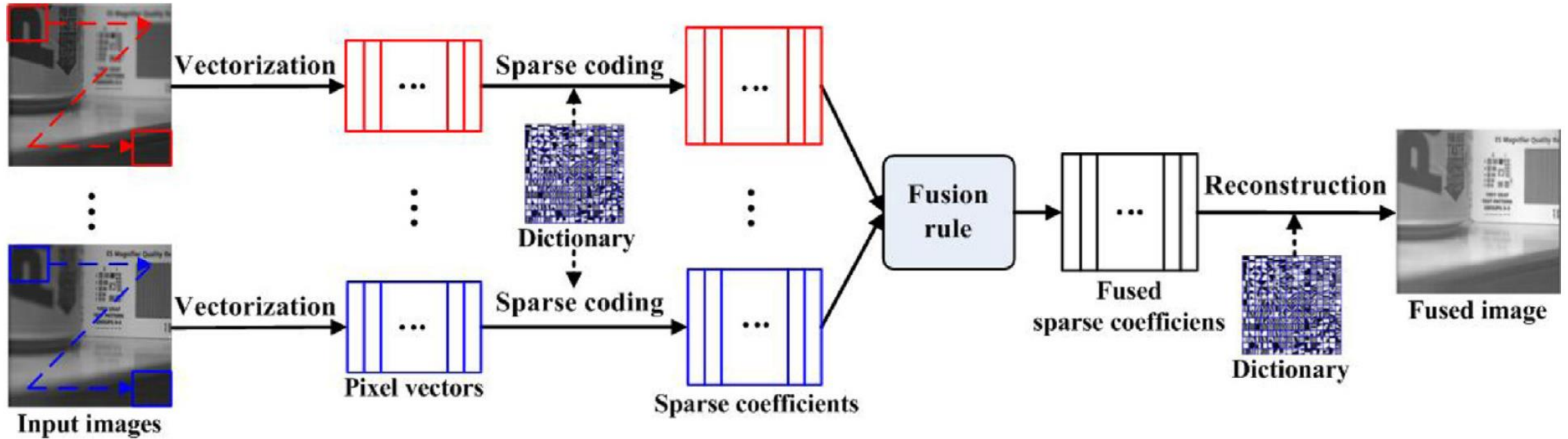
Multi-scale decomposition

Sparse representation (SR)

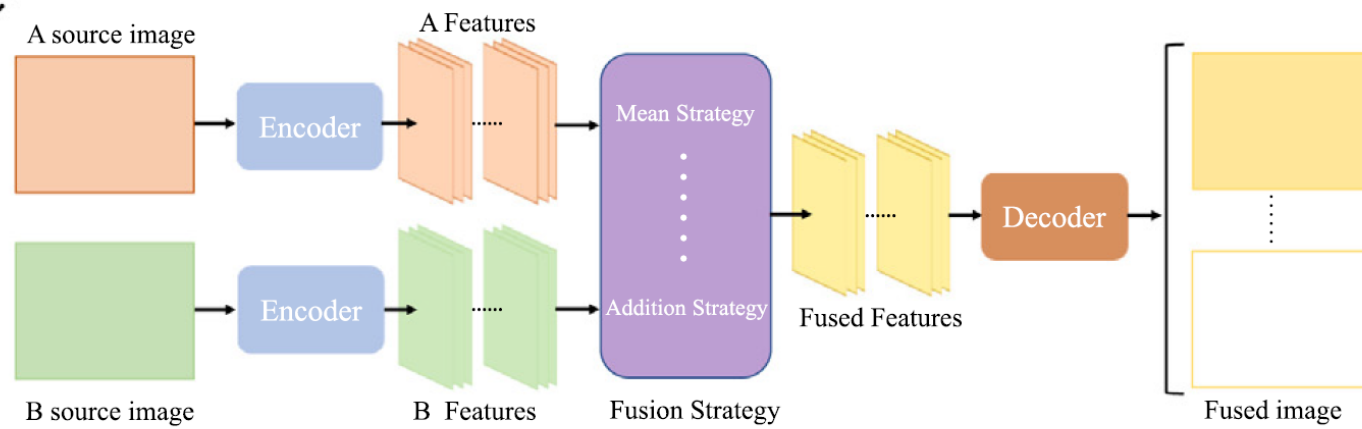
Methods in other domains



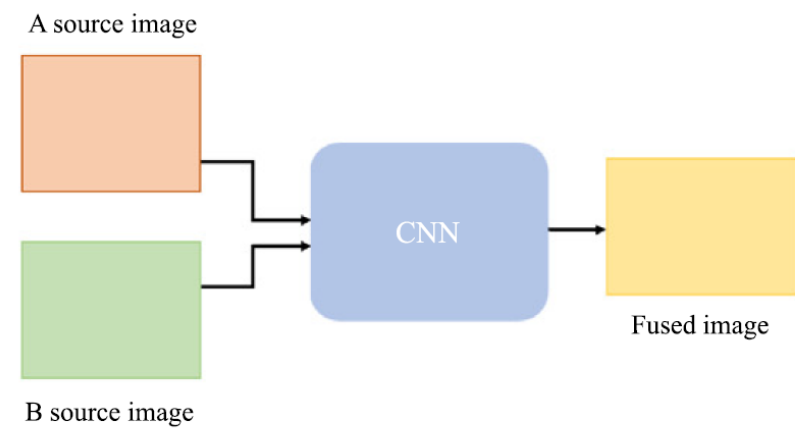
Multi-scale based image fusion



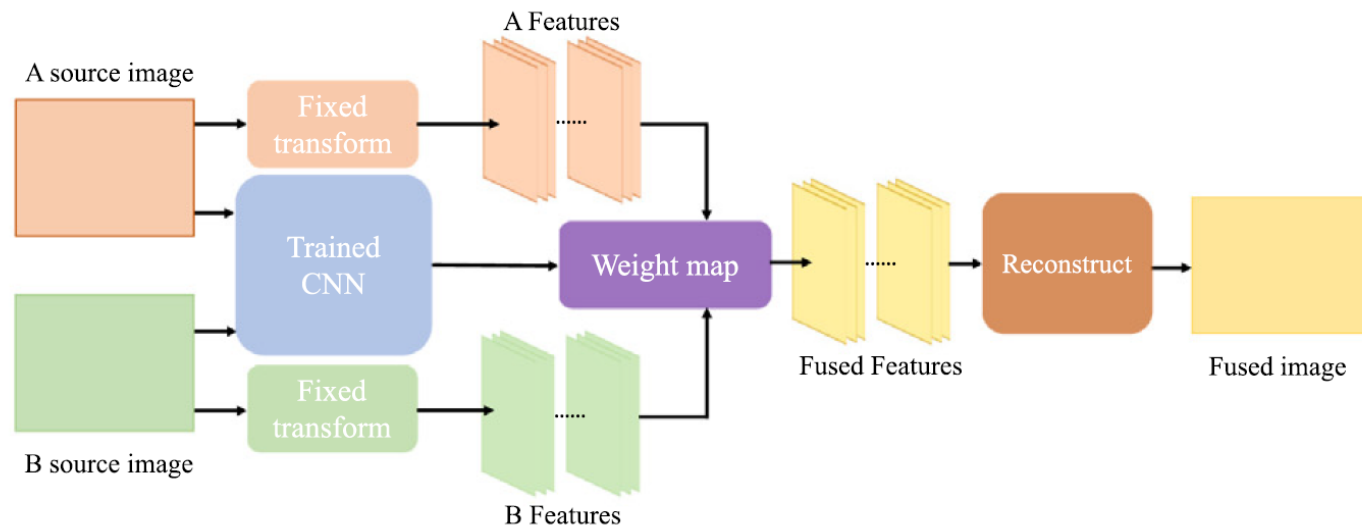
Sparsity based image fusion



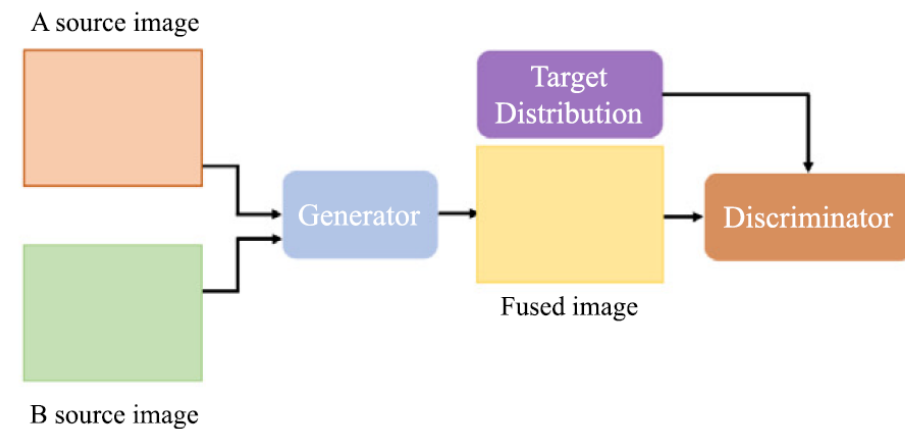
(a)



(b)



(c)



(d)

deep architectures for image fusion.





Near-Focused



Far-Focused



Fused



Underexposed



Overexposed

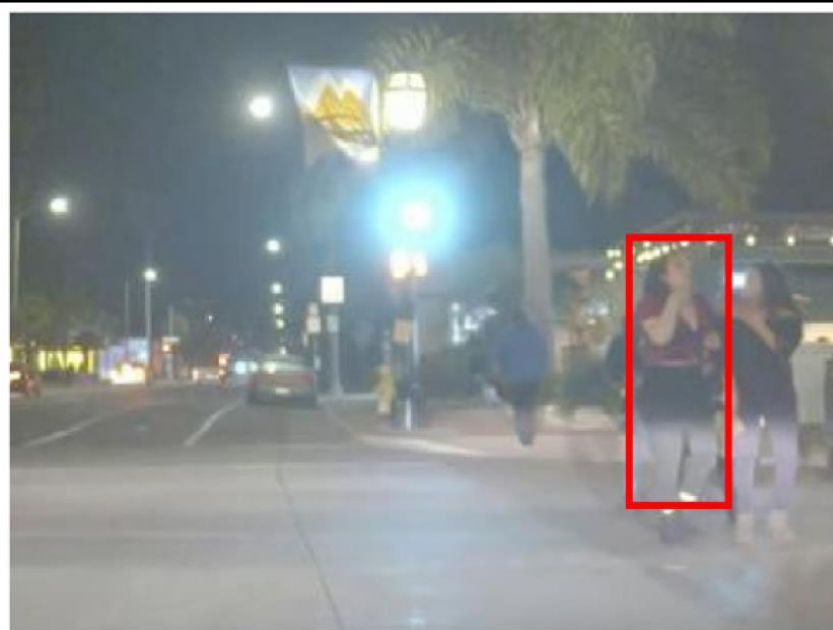


Fused





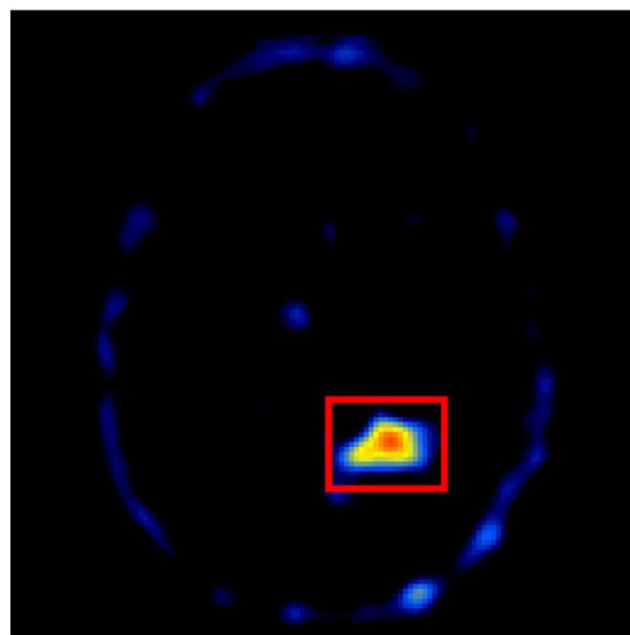
Infrared



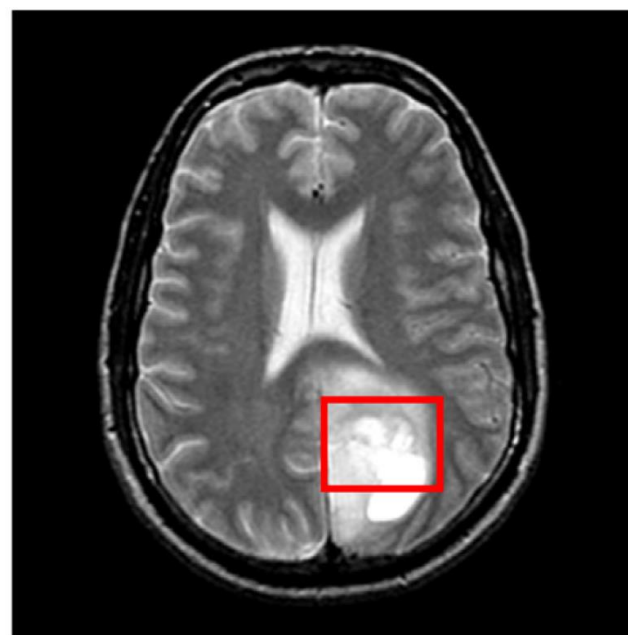
Visible



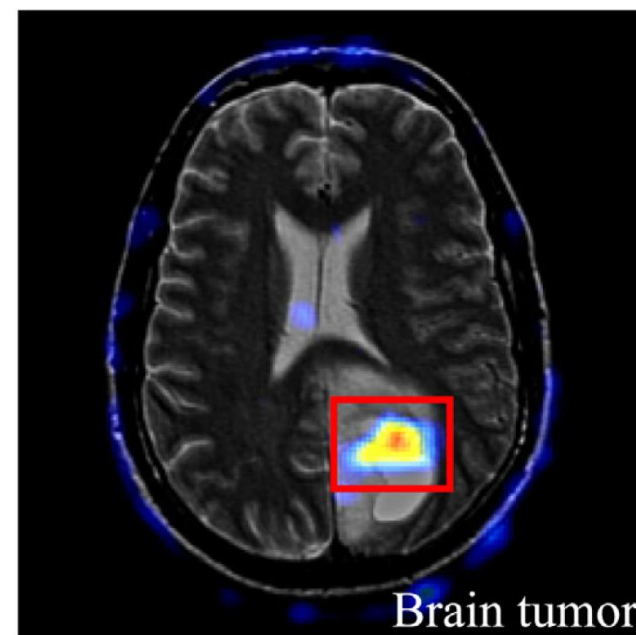
Fused



SPECT



MRI



Brain tumor

Fused