CNN based Framework for Registration of Serial Sections of Whole-slide IHC Images

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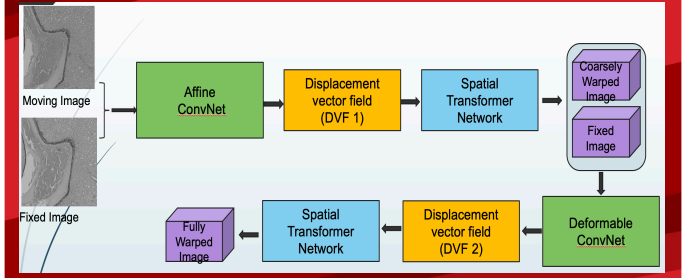
Introduction

- Registration of serial section whole-slide immunohistochemistry(IHC) images.
- We developed deep learning-based framework HistoRegNet having 2 different stages of registration.
- Dataset: 50 WSIs of IHC stained bio marker for mouse heart images
- First each WSI is preprocessed with classical intensity-based transformation to pair-wise register the WSIs.
- The pre-aligned WSIs are further registered using deep learning-based registration model.
- Stage1 : Affine ConvNet to estimate the affine transformation parameters which will coarsely warp the moving image.
- Stage2 : Deformable ConvNet to estimate final displacement vector field to generate the final warped image registered to the reference image.

Model Structure

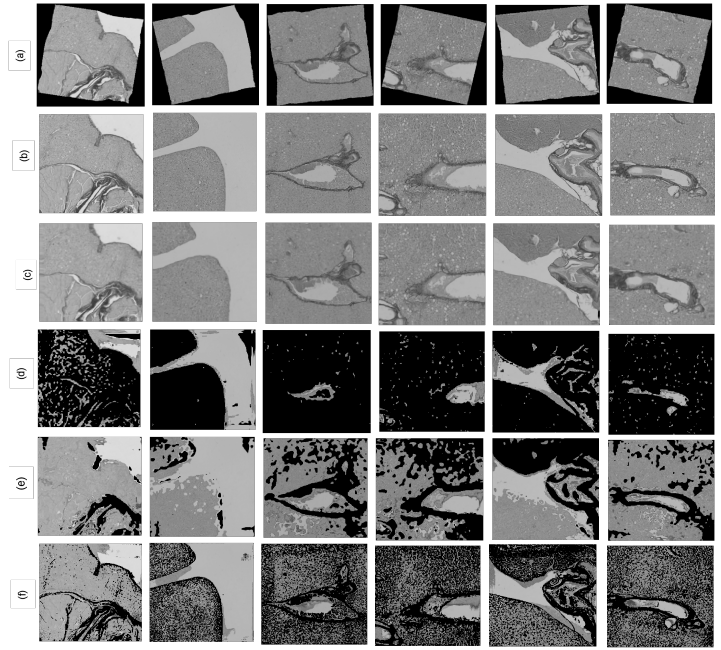


Total loss = similarity loss + regularization loss
similarity loss = ncc(u, y) + ncc(z, y)
regularization loss = 0.3 * gradient loss + 0.7 * TVS loss

Quantitative Results

Method Name	Metric name			
	NCC	SSIM	MSE	NMI
HistoReg -Net	-0.337	0.279	0.003	0.173
DirNet	0.423	0.459	0.289	0.058
FCN	-0.314	0.310	0.015	0.171
UNet	-0.410	0.385	0.117	0.184
FAIM	-0.001	0.362	0.108	0.008

Experimental Results



(a): Moving Image, (b): Reference Image, (c): Our method, (d): DirNet, (e): FCN, (f): UNet.