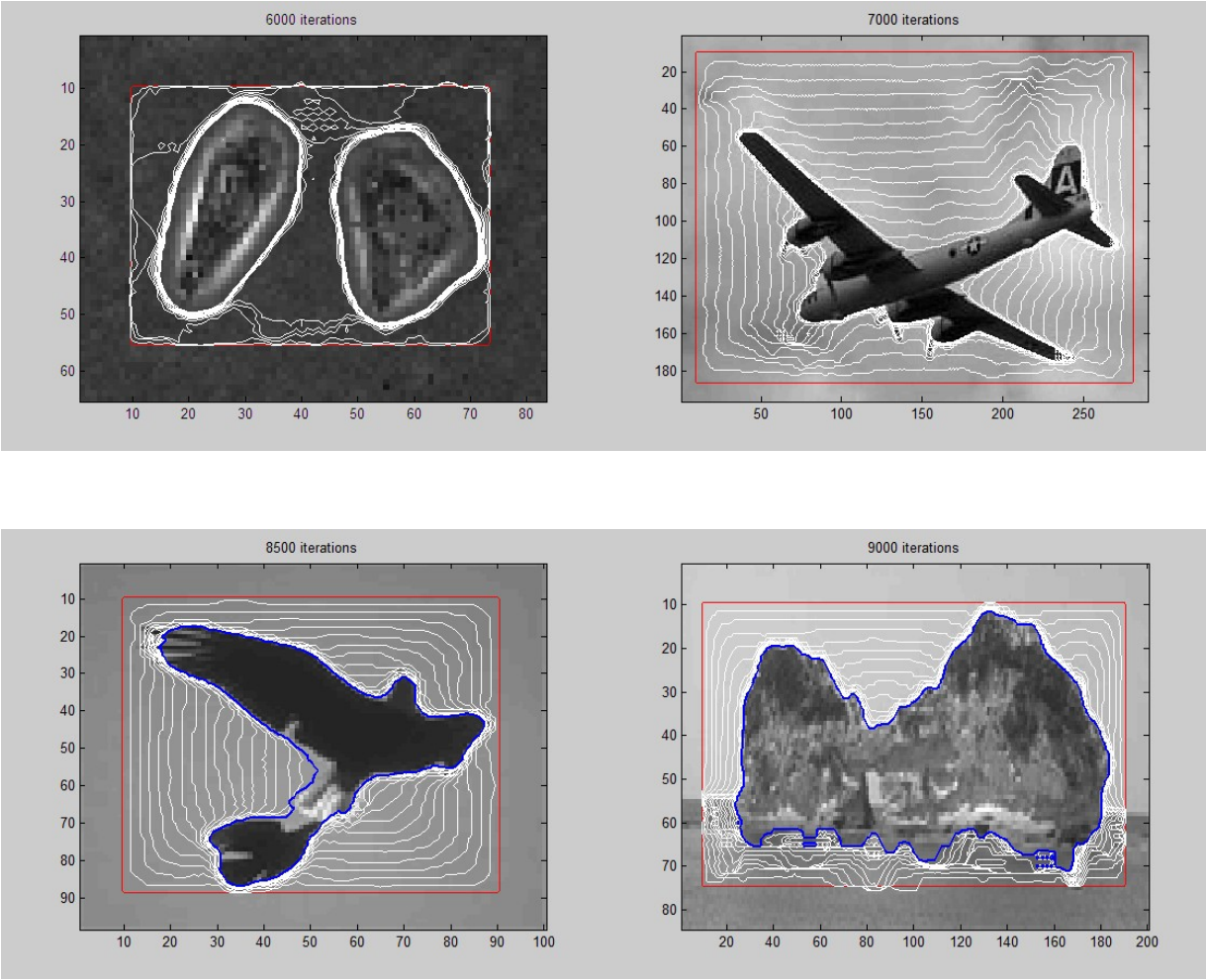
Re-initialization Free Level Set Evolution via Reaction Diffusion-Supplementary Materials

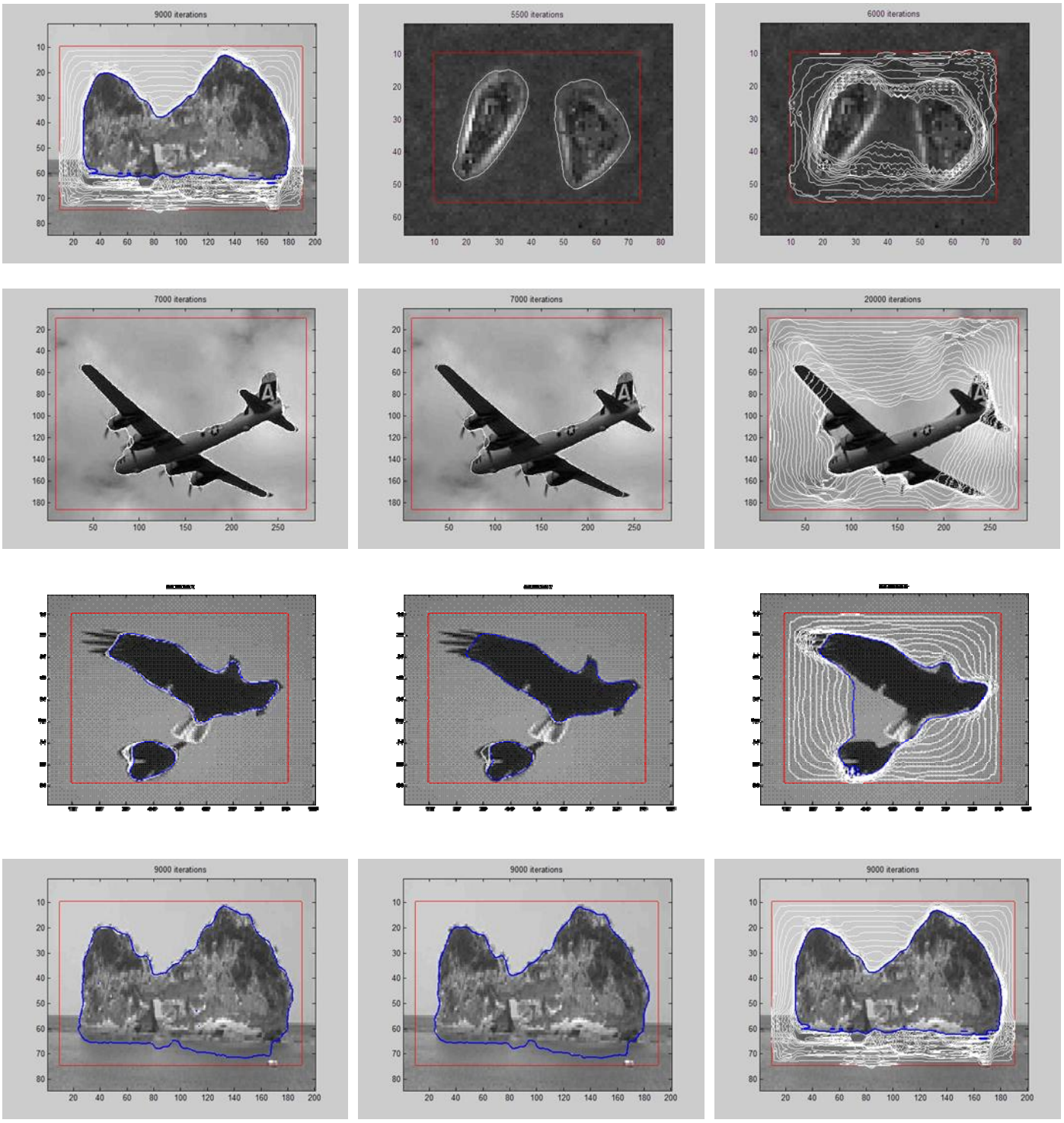
Kaihua Zhang, Lei Zhang, Huihui Song, David Zhang
Dept. of Computing, The Hong Kong Polytechnic University, Hong Kong, China

Some Experimental Results in our paper:
1. Segmentation of example images with weak edges
(a) $\delta_{1,\rho}(\phi)$ is used.

Results by our RD method [1].



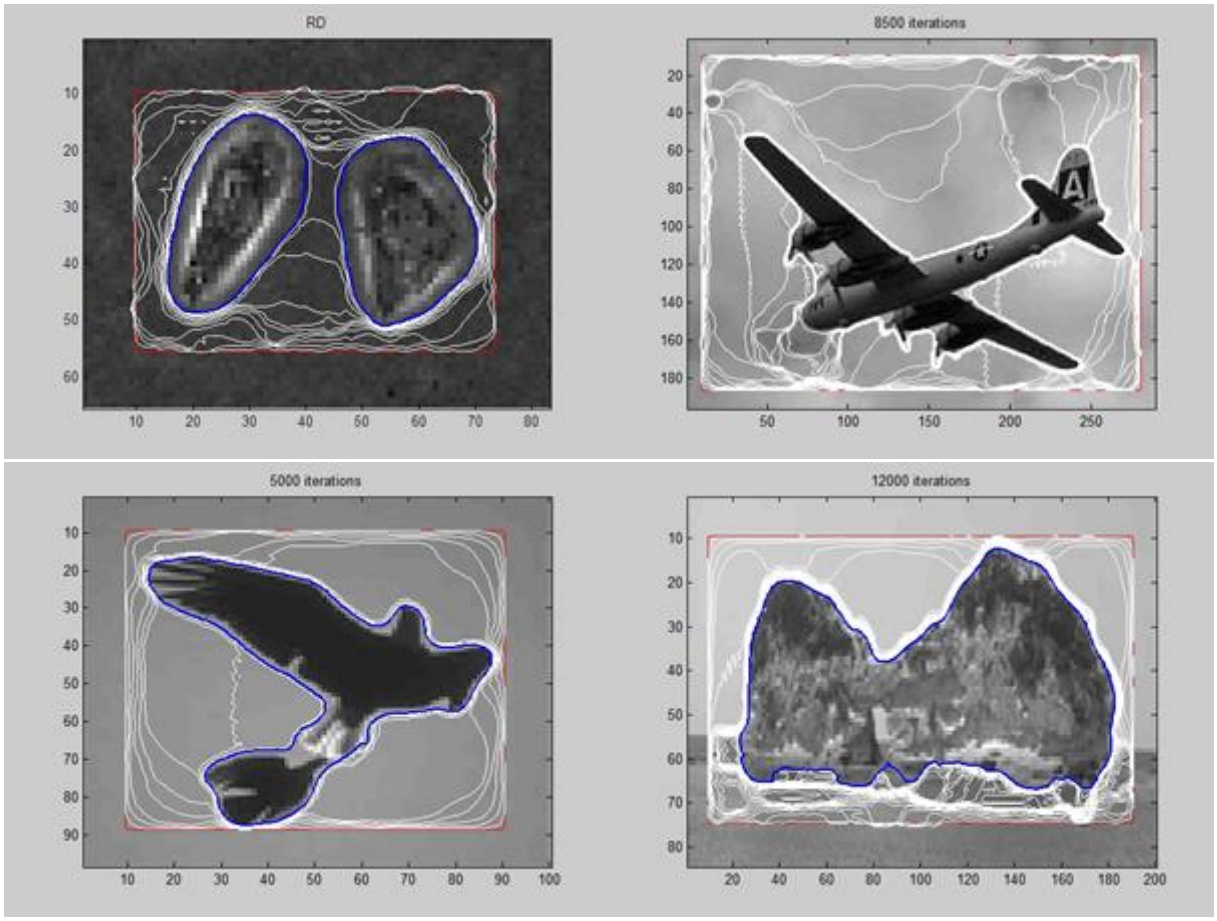
Results by GDRLSE1 [10], GDRLSE2 [10] and GDRLSE3 [6],respectively. For GDRLSE1 and GDRLSE2, time step is set as Δt=5 as in the original paper.



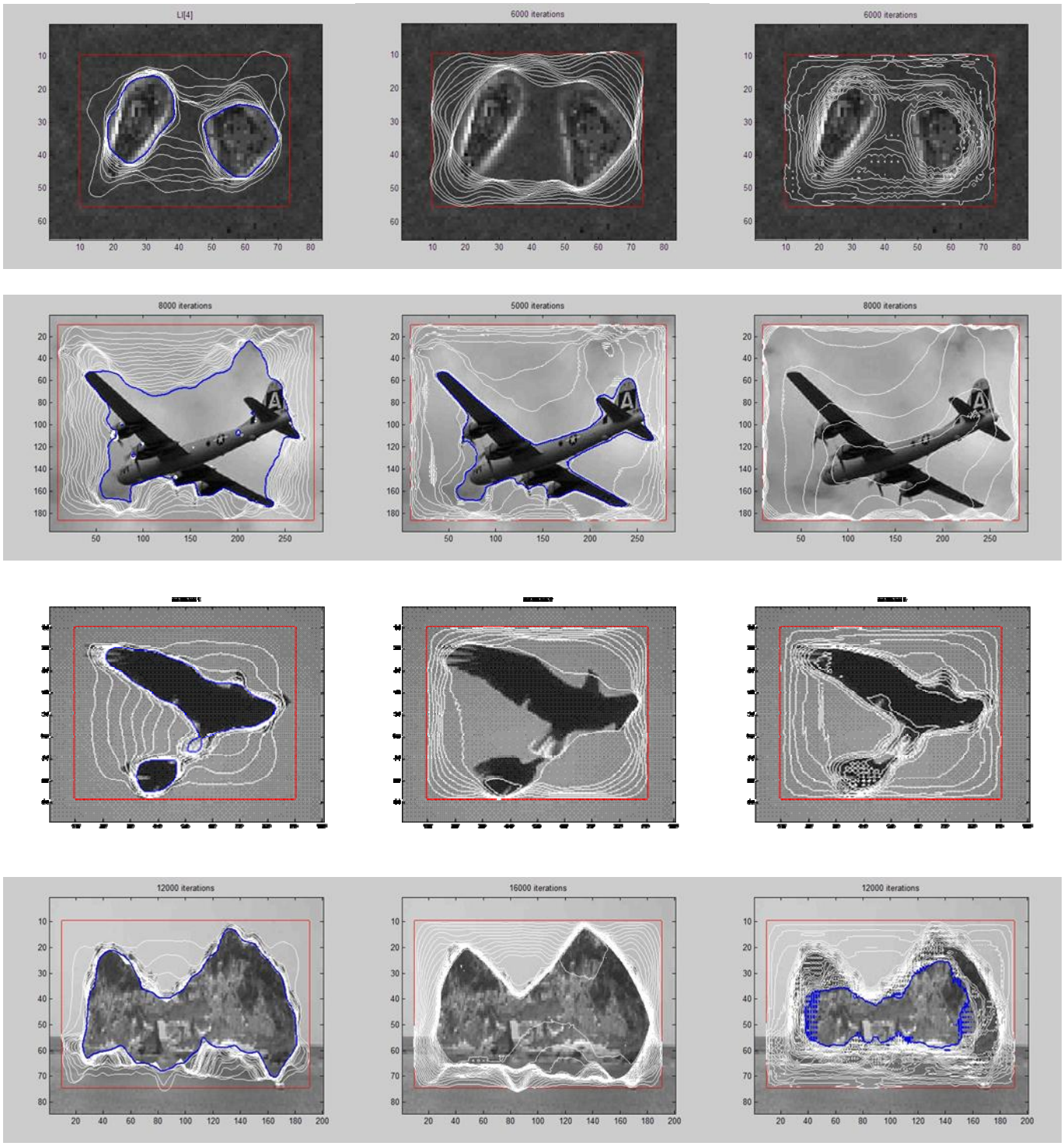
GDRLSE1 **GDRLSE2** **GDRLSE3**

(b) $\delta_{2,\rho(\phi)}$ is used.

Results by our RD method [1].

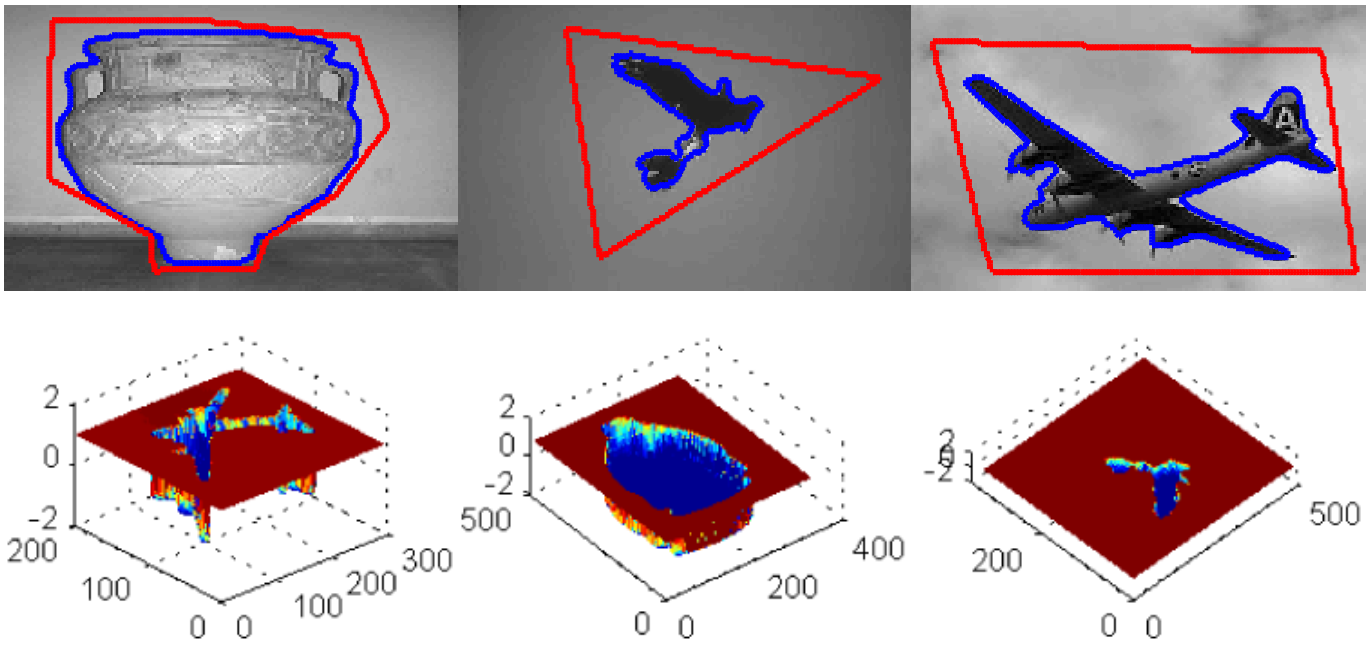


Results by GDRLSE1 [10], GDRLSE2 [10] and GDRLSE3 [6], respectively.

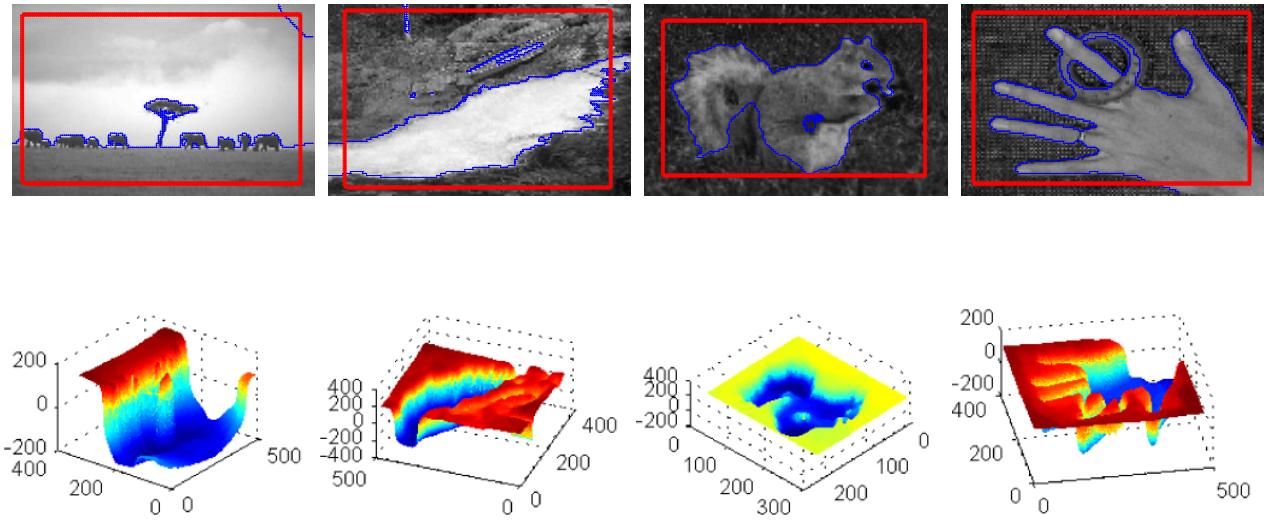


GDRLSE1 **GDRLSE2** **GDRLSE3**

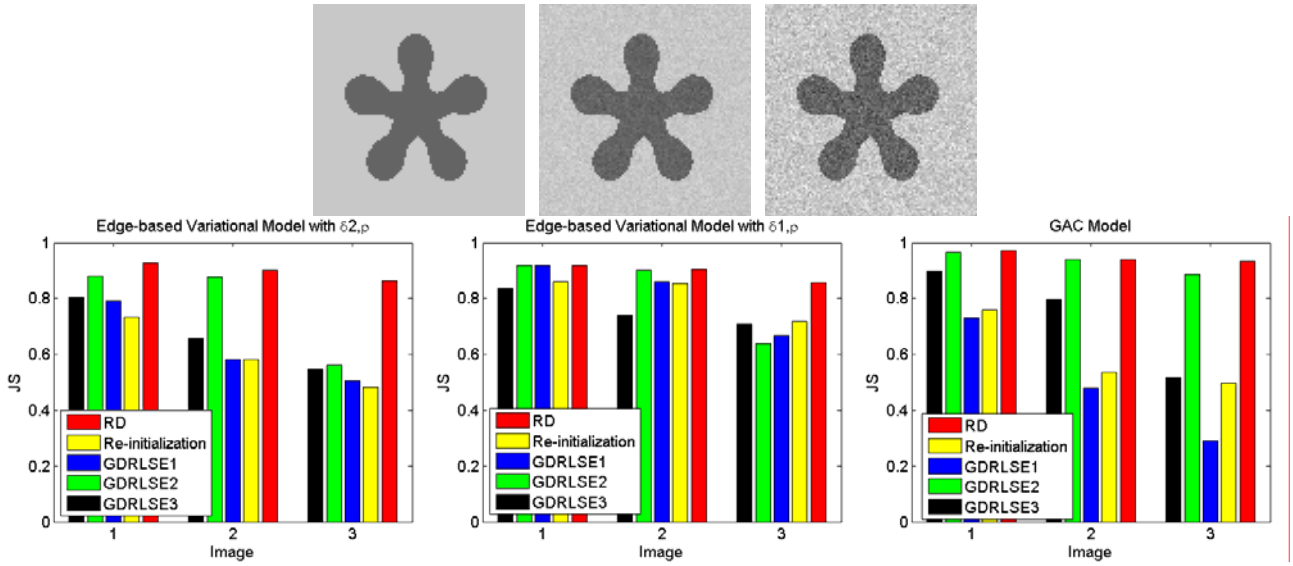
2. Segmentation results on three images in the Corel dataset (downloaded from [46]). Top row: initial contours (red lines) and final contours (blue lines). Bottom row: final LSFs. Parameter settings: Left-most column and right-most column: $\Delta t1$=0.1, $\Delta t2$=0.001, ν=0.5; Middle column: $\Delta t1$=0.1, $\Delta t2$=0.001, ν=0.1.



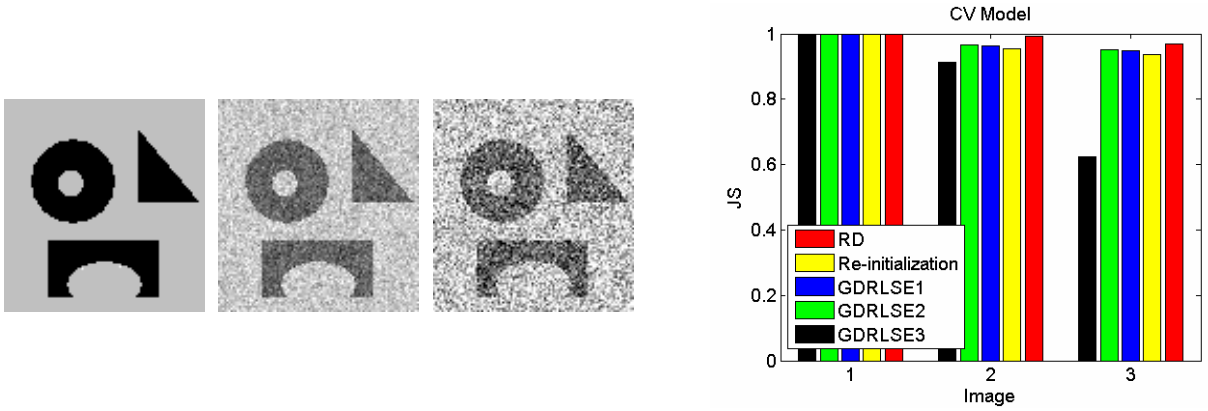
3. Segmentation results on four real images (top two: downloaded from [46]; bottom two: downloaded from [47]). Top row: initial contours (red lines) and final contours (blue lines). Bottom row: final LSFs. We set the parameters $\Delta t1$ =0.1, $\Delta t2$ =0.01, μ=0.2×2552, ν=0, $\lambda 1=\lambda 2$=1 for all images except for the squirrel image, for which we set μ=0.1×2552.



4. Quantitative comparisons among RD and GDRLSE methods for edge-based models. Top row, from left to right: clean image (image 1), noisy image (image 2) (Gaussian noise with zero mean and standard deviation σ=0.001), and noisy image (image 3) (Gaussian noise with zero mean and standard deviation σ=0.005). Bottom row, from left to right: the JS values using the edge-based variational model with $\delta_{2,\rho}$ and $\delta_{1,\rho}$ in Section 5.3, and GAC model in Section 5.4, respectively. For edge-based variational models, we set Δt_1=0.1, Δt_2=0.001, α=0.2, λ=1, ν=0.05 for all the three images. For the GAC model, we set Δt_1=0.1, Δt_2=0.001, α=0.2, λ=1 for all the three images, and we set ν=0.05, ν=0.2, ν=0.5 for the images from left to right.

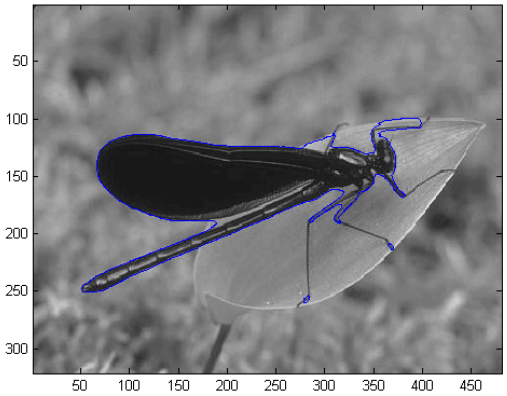


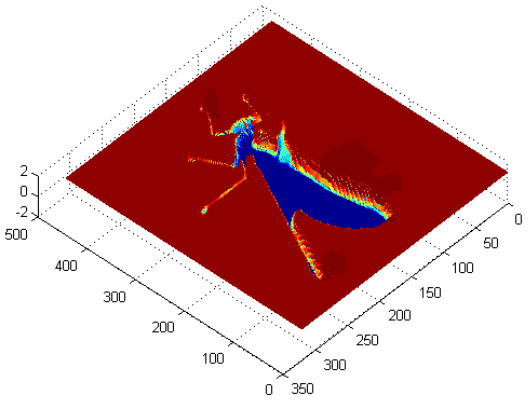
5. Quantitative comparisons among RD, re-initialization, and GDRLSE methods for the CV model [18]. Left three images: clean image, images with Gaussian noise of zero mean and standard deviation σ=0.01, σ=0.05, respectively. Right image: the JS values by competing methods. We set Δt_1 =0.1, Δt_2 =0.01, μ=0.1×2552, ν=0, λ_1=λ_2=1 for all three images.

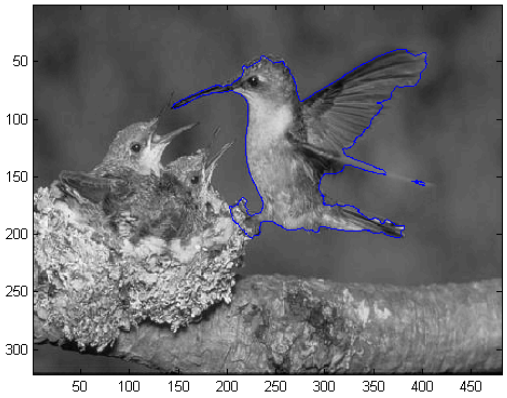


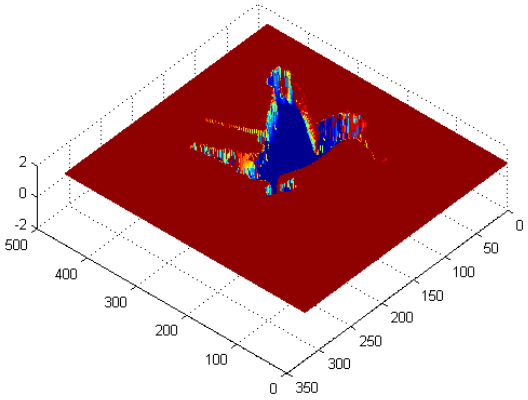
More Experimental Results :

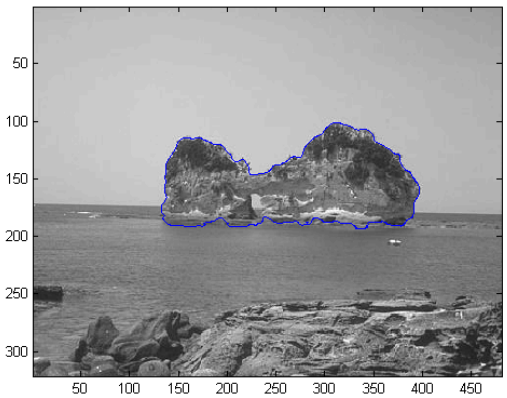
1. Apply to GAC model [7].

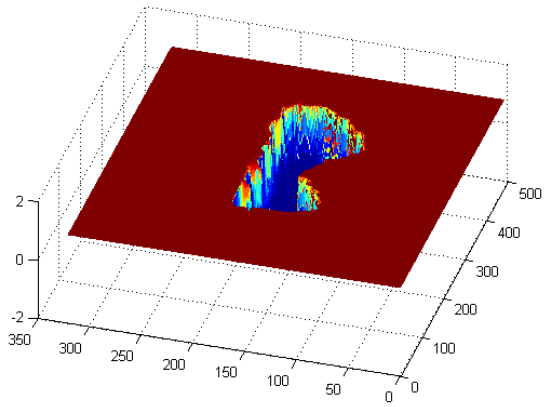


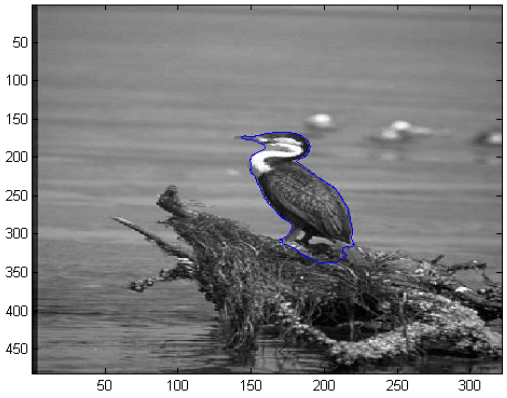


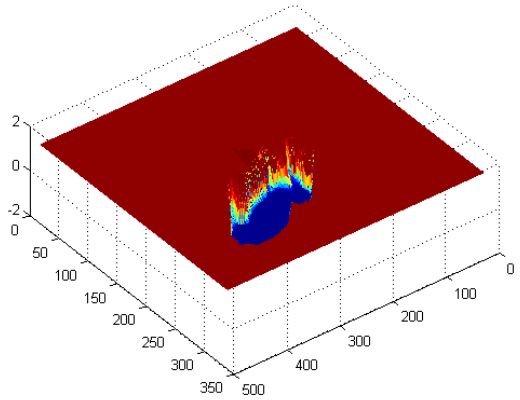


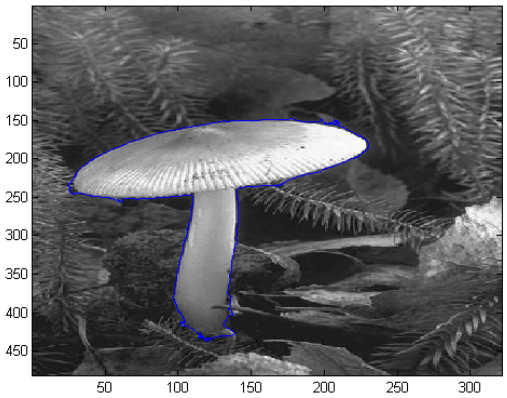


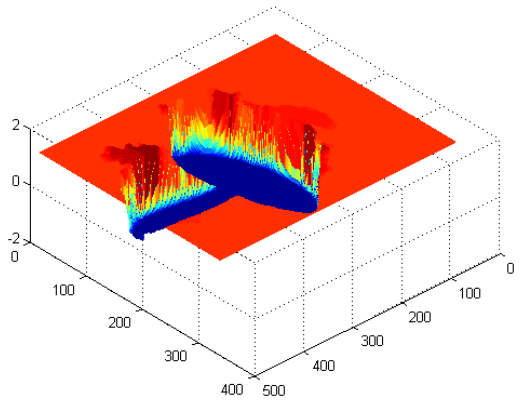








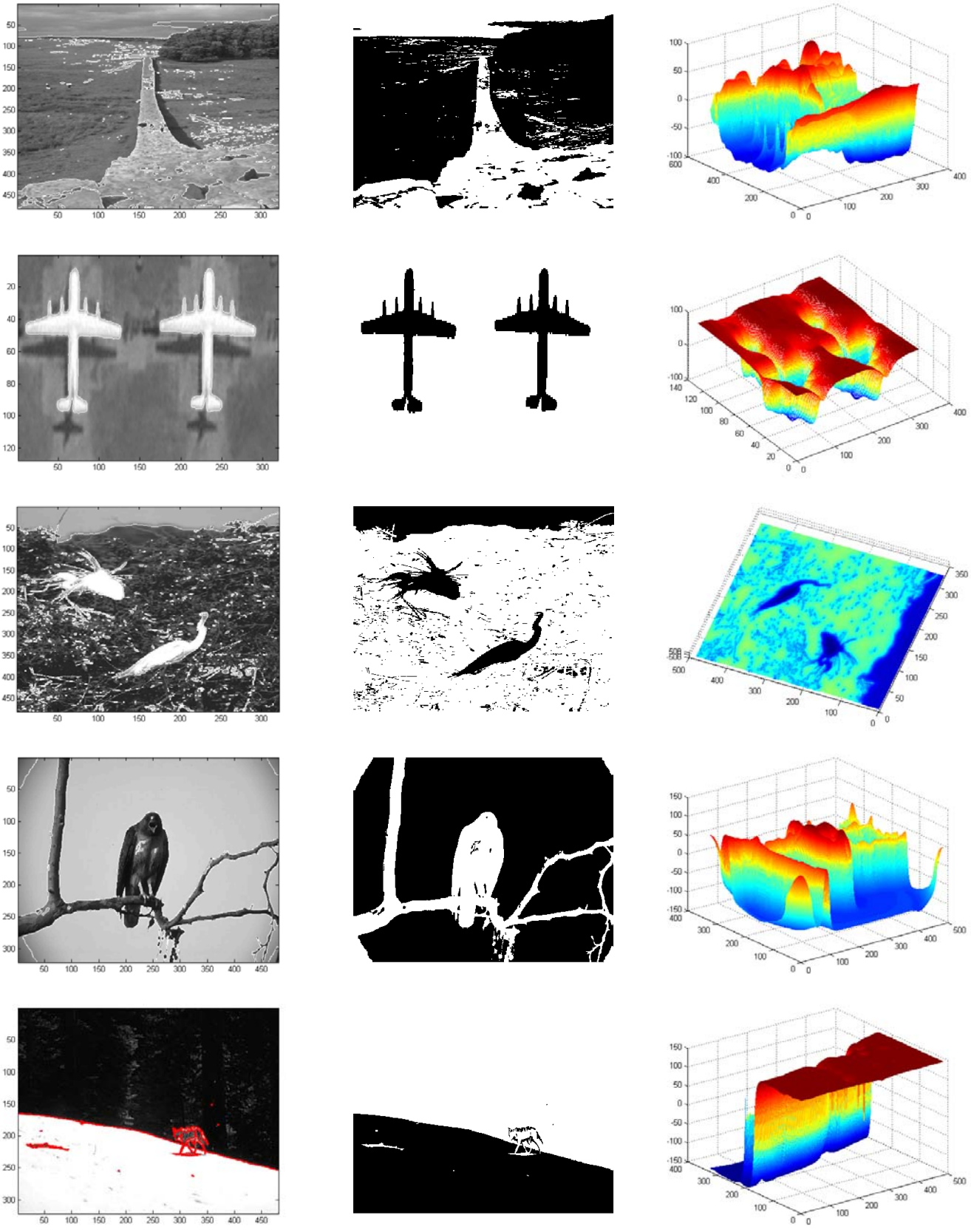


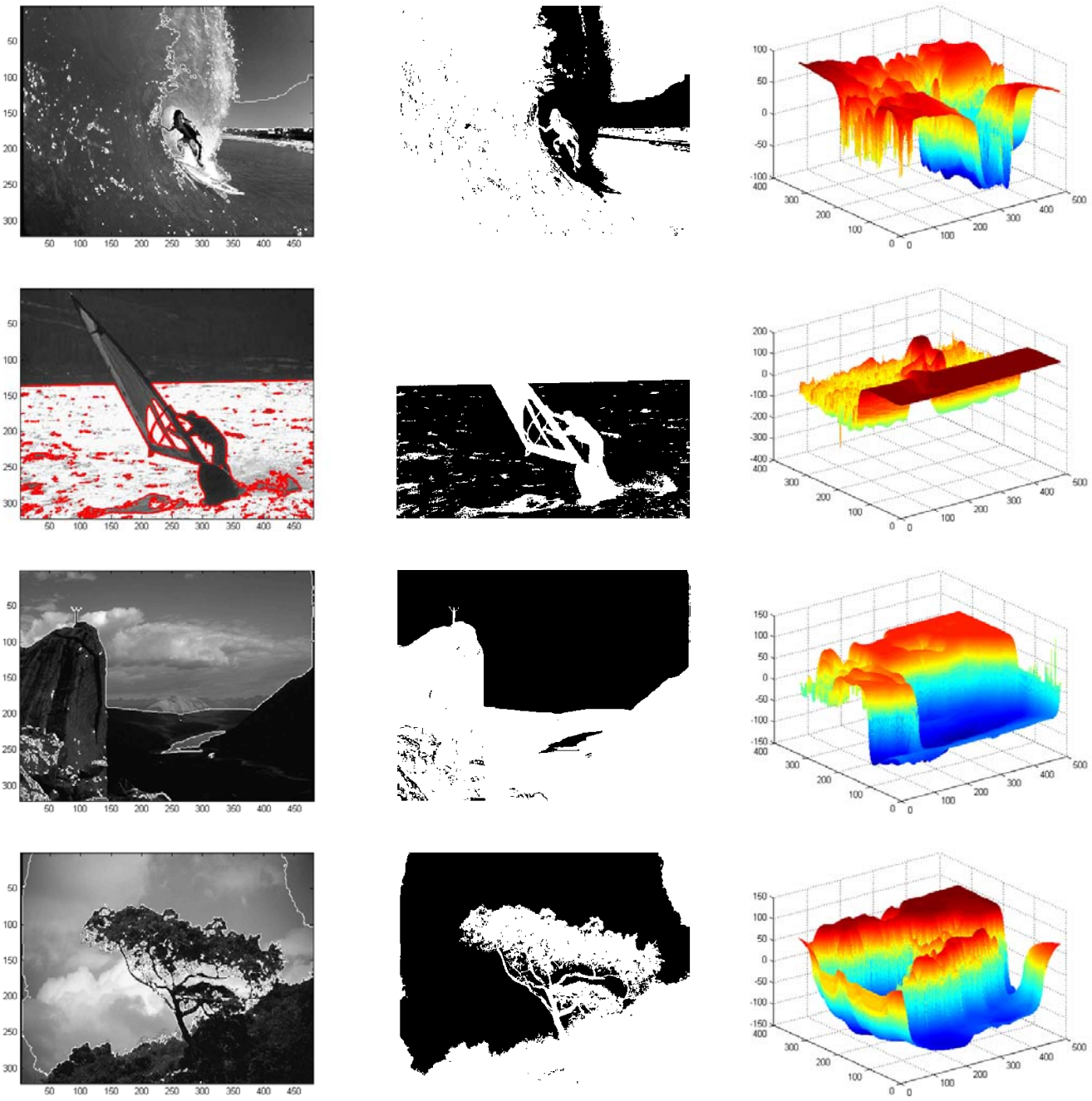


Segmentation results

Final LSF

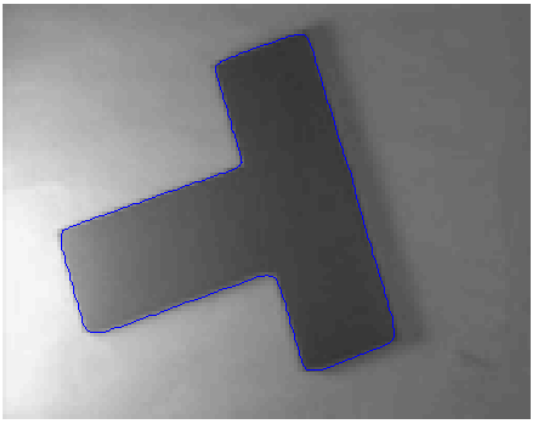
2 . Apply to CV model [8].

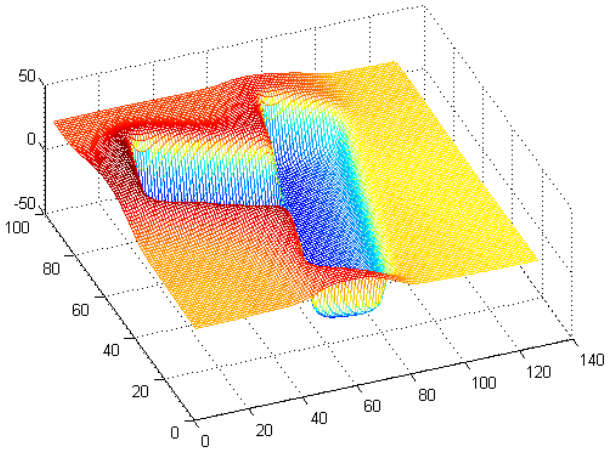


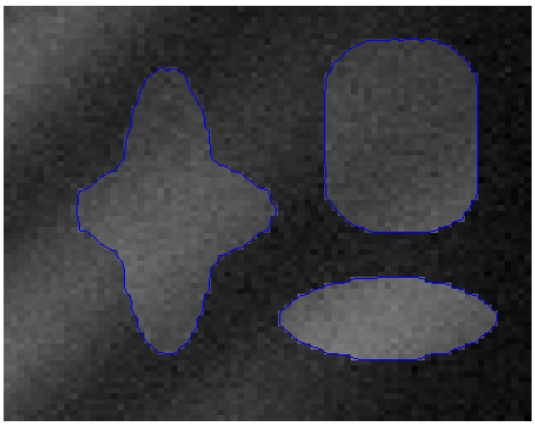


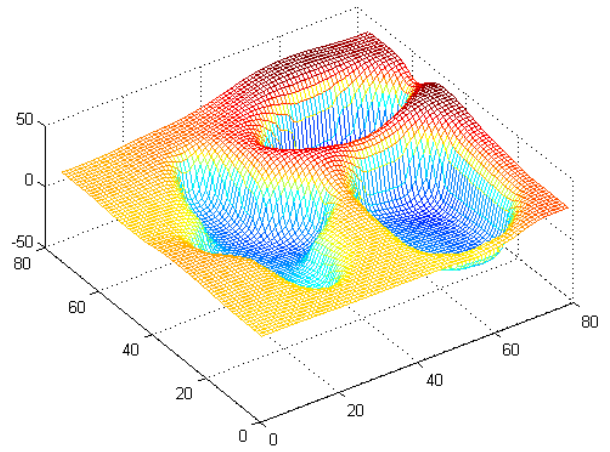
(a) Results represented by boundaries (b) Results represented by regions (c) Final LSF

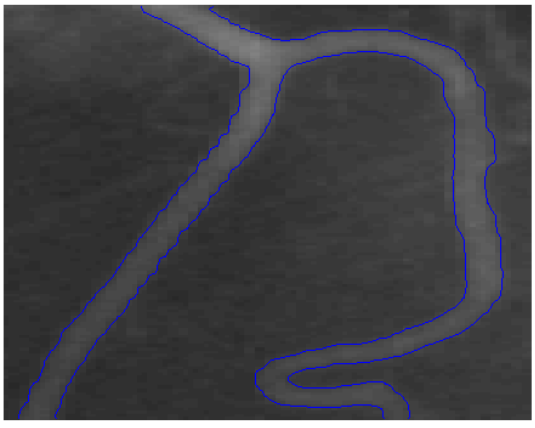
3 . Apply to LBF model for images with intensity inhomogeneity [9].

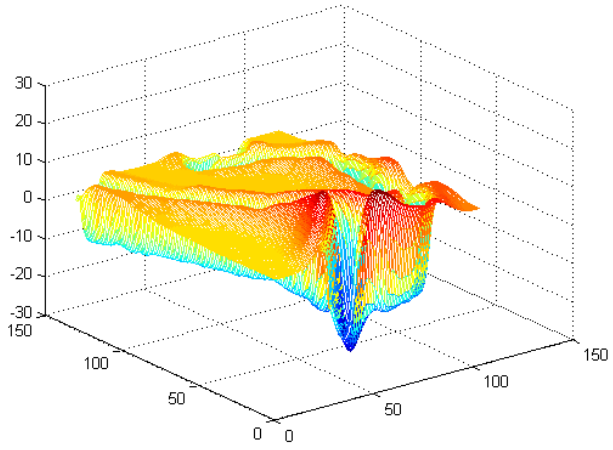


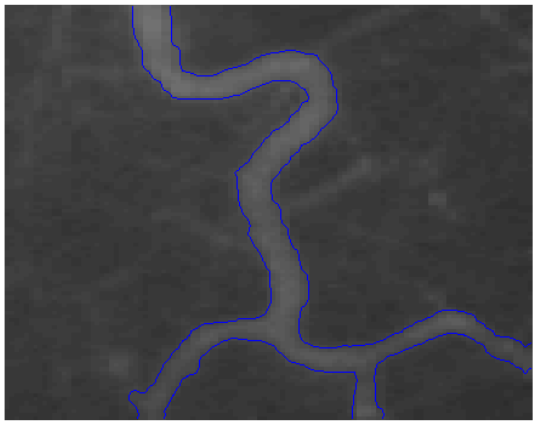


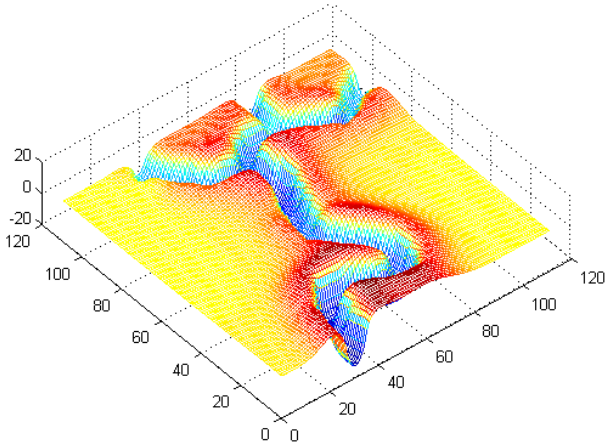


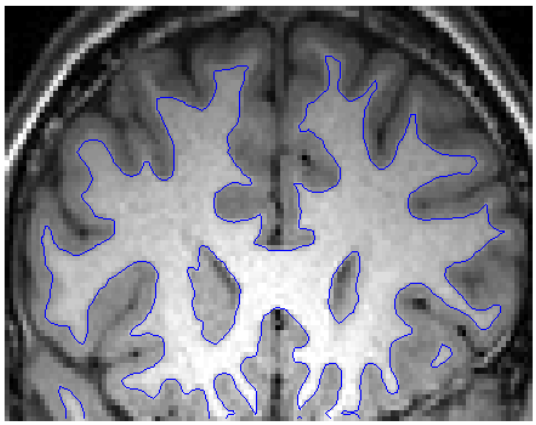


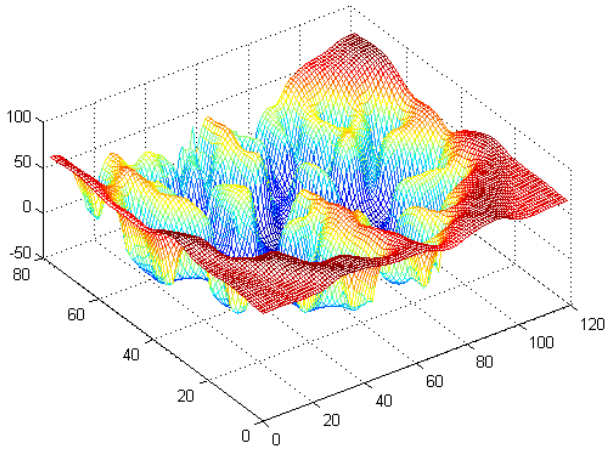












(a) Final Results **(b) Final LSF**

References:

[1] K.Zhang, L.Zhang, H.Song, and D.Zhang, Re-initialization Free Level Set Evolution via Reaction Diffusion. IEEE Trans. On Image Processing.

Our former related work

[2] K.Zhang, L.Zhang, H.Song and W. Zhou, "Active contours with selective local or global segmentation: a new formulation and level set method," Image and Vision Computing, vol. 28, issue 4, pp. 668-676, April 2010.
[3] K.Zhang, H.Song, and L.Zhang, "Active contours driven by local image fitting energy," Pattern recognition, vol.43, no.4, pp.1199-1206, 2010.
[4] K.Zhang, L.Zhang and S.Zhang, "A VARIATIONAL MULTIPHASE LEVEL SET APPROACH TO SIMULTANEOUS SEGMENTATION AND BIAS CORRECTION," ICIP 2010.

Other related work

[5] C. Li, C. Xu, C. Gui, and M. D. Fox, "Level set evolution without re-initialization: A new variational formulation," Proc. IEEE Conf. Computer Vision and Pattern Recognition, vol. 1, pp. 430–436, 2005.

[6] X.Xie, “Active Contouring Based on Gradient Vector Interaction and Constrained Level Set Diffusion,” IEEE Trans. Image Processing, vol. 19, no. 1, pp. 154-164, 2010.
[7] V.Caselles, R.Kimmel, and G.Sapiro, “Geodesic Active Contours,” Int. J. Comput. Vis., vol.22, no.1 pp. 61–79,1997.
[8] T. Chan and L. Vese, “Active contours without edges,” IEEE Trans. Image Process, vol. 10, no. 2, pp. 266–277, Feb. 2001.
[9] C. Li, C. Kao, J. Gore, and Z. Ding, “Implicit Active Contours Driven by Local Binary Fitting Energy,” Proc. IEEE Conf. Computer Vision and Pattern Recognition, pp. 1–7, 2007.
[10]C. Li, C. Xu, C. Gui, and M. D. Fox, “Distance Regularized Level Set Evolution and Its Application to Image Segmentation,” IEEE Trans. Image Processing, vol. 19, no. 12, pp. 154-164, Dec. 2010.