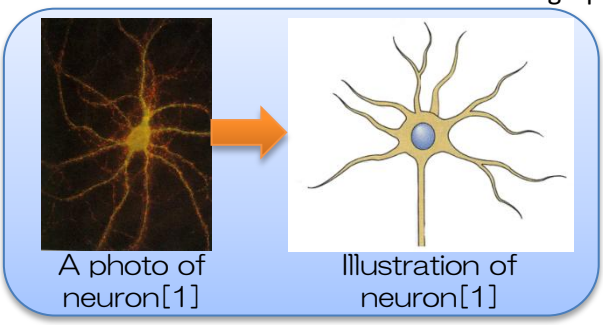
How to Draw Illustrative Figures?

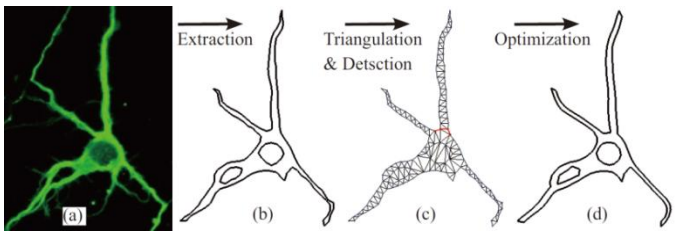
Yuki Morimoto, Tokyo Denki University (ISIT until March), morimoto@im.dendai.ac.jp Daisaku Arita, ISIT

1. Goal: Illustrative Beautification of Photograph



[1] Mark F Bear, Barry W Connors, Michael A Paradiso: Neuroscience: Exploring the Brain, Lippincott Williams & Wilkins; Third edition (February 7, 2006)

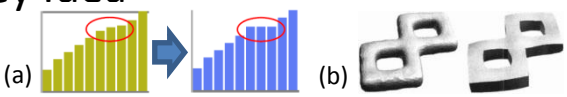
2. System Overview



Input [2] Contours Measuring & smoothing Fitting

[2] Millet LJ, Stewart ME, Sweedler JV, Nuzzo RG, Gillette MU. Microflu-idic devices for culturing primary mammalian neurons at low densities.Lab Chip 2007;7(8):987–94.

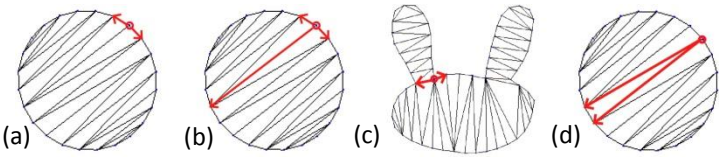
3. Key Idea



Feature preserving & enhancing filtering [3]
(a) Values of before & after the filtering .
(b) An effect of the filtering (Right).

<Assumption> Appling the filtering to design factors, which are parallelism, collinearity, curvature smoothness, etc, result in enhanced illustrative figures.

[3] Yutaka Ohtake, Alexander G. Belyaev: Nonlinear Diffusion of Normals for Stable Detection of Ridges and Ravines on Range Images and Polygonal Models. MVA 2000: 497-500



Figures for 4 and 5

4. Measuring & Detection of Design

(d) For parallelism, we measure an average distance between the target vertex and connected vertices.
(c) For collinearity, we measure curvatures which is the most smooth and connected vertex using the method [4].

[4] Hongbo Fu, Shizhe Zhou, Ligang Liu, Niloy J. Mitra: Animated construction of line drawings. ACM Trans. Graph. 30(6): 133 (2011)

5. Anisotropic Diffusion Pass

(a) Diffusion pass for curvature smoothing filtering.
(b) Diffusion pass for unsigned curvature smoothing filtering.
(c) Diffusion pass for collinearity filtering.
(d) Diffusion pass for parallelism filtering.

6. Optimization for Fitting

$$E_{sm} = \int_\Omega (\kappa - \kappa')ds, \quad E_d = \int_\Omega (d - d')ds,$$

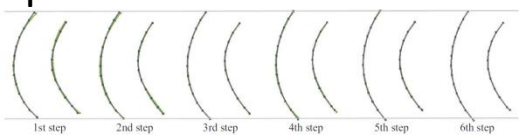
$$E_c = \int_\Omega (\kappa_c - \kappa_c')ds, \quad E_{si} = \int_\Omega (\kappa_u - \kappa_u')ds, \quad E_p, E_{in}$$

$$E = k_{sm}E_{sm} + k_dE_d + k_cE_c + k_{si}E_{si} + k_pE_p + k_{in}E_{in},$$

Mesured and detected values are enhanced by the filtering.
Then we apply the fitting method [5] to solve the optimization program.

[5] Curvature-Domain Shape Processing, Michael Eigensatz, Robert W. Sumner, Mark Pauly,Computer Graphics Forum (Proceedings of Eurographics) 2008

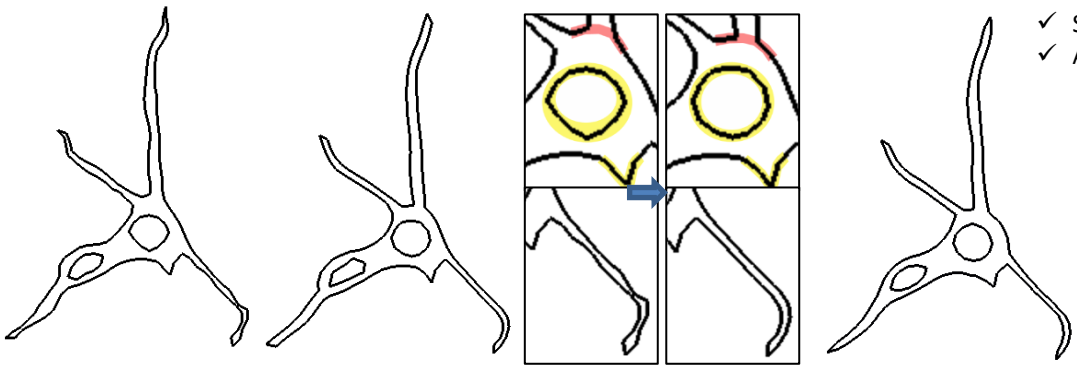
7. Experimentation



The figure above is our experimental results with parameters that enhance parallelism. The step numbers indicate how many times the filtering & optimization were applied.

We have other experimental results with parameters that enhance curvature smoothness, collinearity and unsigned curvatures smoothness (which enhanced local similarity).

8. Results



Original contours Result Comparison Experimental result by UI Experimental UI

Comparison: Collinear part (red), curvature smoothness(yellow), parallelism (bottom)

Experimental UI for user specified collinearlity part

9. Future Work

- ✓ Sensitive parameter setting
- ✓ Apply this to drawing application