

DETECTION OF SPARSE 3D LINES USING STATISTICAL MOMENTS IN GAUSSIAN WINDOW

Jiří Janáček

Institute of Physiology of the CAS

Vídeňská 1083, 14220 Praha 4, Czech Republic

E-mail: jiri.janacek@fgu.cas.cz

KEY WORDS: line filtering, 3D imaging, length measurement, registration.

Measurement of blood vessels in tissues [1] and linear feature-based registration of images [2] are tasks requiring automatized detection of 1D structures in 3D images. Line filtering is an important step in detection of the curvilinear structures and general-purpose algorithms for such an approach are available [3].

Sparse character of some biological curvilinear features, e.g. blood vessels in tissue samples or ribs in laboratory animals where the linear structures are surrounded by void regions, enables to design of specialized filter with superior sensitivity and robustness. The filter uses the statistical moments of Gaussian windows to estimate the saliency, position and direction of the curvilinear feature in the vicinity of each position and it accumulates the results to obtain an enhanced image. The filter depends on one parameter only, namely the size of the Gaussian filter.

The implementation is very efficient because it uses only Gaussian filtration and 1st and 2nd partial derivatives of the filtered image. We implemented the filter in ImageJ plugin `Tensor_Line_3D`.

The research is supported by CZ.02.1.01/0.0/0.0/16_013/0001775 Modernization and support of research activities of the national infrastructure for biological and medical imaging Czech-BioImaging funded by OP RDE and MEYS (LTC17023 INTER-COST).

[1] J. Janáček, E. Cvetko, L. Kubínová, L. Travník, I. Eržen, “A novel method for evaluation of capillarity in human skeletal muscles from confocal 3D images,” *Microvascular Research*, **81**, 231–238 (2011).

[2] E. Serradell Eduard, M. A. Pinheiro, R. Sznitman, J. Kybic, F. Moreno-Noguer Francesc, P. Fua, "Non-rigid graph registration using active testing search," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, **37**, 625-638 (2015).

[3] A. F. Frangi, W. J. Niessen, K. L. Vincken, M. A. Viergever, “Multiscale vessel enhancement filtering,” in: Medical Image Computing and ComputerAssisted Intervention-MICCAI’98, 130–137 (Springer, 1998)