Fakulta rybářství   Jihočeská univerzita
a ochrany vod   v Českých Budějovicích
Faculty of Fisheries University of South Bohemia
and Protection   in České.Budějovice
of Waters   Czech Republic

Supervisor assessment of the PhD candidate Tomáš Náhlík

Tomáš Náhlík started his PhD in September 2009. It was relatively early after the time when, in September 2005, Dalibor Štys, Jan Urban and Jan Vaněk started a new research direction aiming at analysis of the information content of experiment. Jan Urban eventually became the specialist supervisor of Tomáš Náhlík. Tomáš Náhlík contributed significantly to this rather in-depth looking approach to experimental science.

In his study time he participated in three main research projects: assessment of microscopy information, self-organisation on the Belousov–Zhabotinsky reaction and development of the bioWES knowledge base for registration of experimental knowledge. The submitted thesis Microscopy – Point Spread Function, Focus Resolution is a result of the first of his project lines.

The idea of the project was inspired by pure biological needs to extract automatically cells and their features from the time-lapse experiment. We have also learned from our colleagues at the University of Vienna about the videoenhanced microscopy by which it is possible to observe very small objects of the size of small than one pixel at the digital camera. These were inspirations of the fundamental research of the microscopic experiment in biology as information channel which brings information about the biological objects.

First step is understanding and mastering the information content of the data matrix delivered by the digital camera. Tomáš Náhlík has participated in the development and testing of the appropriate software which is now called Image Explorer. It enables visual analysis of the primitive 12 or 16 bit depth matrix by visualisation on the computer screen which has the 8 bit depth. It also enables us to analyse each colour channel separately. This is far more adequate than visual analysis of pseudocolours constructed by combination of colour camera signal since the amount of electromagnetic energy reaching the camera pixel can to be attributed to one single process and should not be interpreted as such. Moreover, most imaging software modifies the original matrix.

The Image Explorer approach is adequate for analysis of a single image. The analysis of a series of images. In such a case we need to ensure that the scale is preserved over the whole series of images. In order to maximise the information preserved from the 12 bit image it was developed a software which expands the scale while omitting all unoccupied intensity levels. That was, from my point of view, Tomáš Náhlík´s major contribution. I believe that for visual inspection of scientific data such approach should become a standard. LIL convertor has been in collaboration with Image Code Company converted into a professional software which is available to the general public.

The content of the proposed thesis is based on thorough analysis of the information from the microscope z-stack series. Tomáš Náhlík started from the theoretical analysis and performed, using known softwares, two types of simulation: simulation of diffraction response of objects of the size which may be anticipated in the living cell and simulation of electrical field intensity of the emitted light behind the microscope lense. In the discussion of these results Tomáš Náhlík concluded in the wavefront behind the objects there must be a point in which the size of the dark image is much smaller than that of the object itself. It is this object which, when transmitted by the microscope optics, is presented as the smallest, most informative, object. By transformation of the microscope

image into the point information gain scale the core of the information about the object may be detected.

Next part of the thesis is the experimental verification of this theoretical assumption. The results of Tomáš and lately also of Dr. Renata Rychtáriková lead to suggestion for microscope design which resulted in construction of three microscope prototypes, a patent application and finally, a comprehensive paper co-authored by Tomáš Náhlík which is presented in the thesis as manuscript abstract.

Tomáš Náhlík also collaborated with the microscopy laboratory of prof. Irene Lichtscheidl at the Faculty of Science, University of Vienna for which he developed an image analysis software.

It may be concluded that Tomáš Náhlík is a skilled and highly independent researcher and very good and reliable partner for collaboration. He is able to design independently both the experiment and the software for its analysis. His weakness is the presentation of results. He is among the best three PhD students of myself and I would recommend him to any scientific position.

Nové Hrady November 23, 2015