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Report on Ing. Michal Havlíček

The submitted thesis of Ing. Michal Havlíček contains his achievements in the subject of multispectral dynamic texture modeling and the state-of-the-art static texture modeling in the forms of bidirectional texture function (BTF) and bidirectional reflectance distribution function (BRDF) during period 2010-2017 in ÚTIA CAS. The material appearance modeling, recognition, particularly the measurement and modeling of bidirectional reflectance function (BTF), and dynamic texture modeling is closely related to the image modeling and statistical multidimensional model-based pattern recognition research pursued in the Pattern Recognition department of ÚTIA CAS and closely match the basic research direction of ÚTIA CAS.

Physically-correct representation and modeling of material light reflectance properties is not only one of the major research problems in computer graphics and vision, but simultaneously also the precondition for further progress in numerous image analysis applications, in areas such as medicine, security, robotics, remote sensing, quality control etc. The corresponding descriptive multidimensional Markovian models representations require to derive non-trivial estimation of their statistics as well as efficient synthesis methods development. This is also the subject solved in the submitted thesis - the adaptive, data-driven measurements of the most advanced visual surface representations which can be recently applied - the bidirectional texture function.

The aim of his work was to study novel descriptive multidimensional Markovian textural models and to improve physically correct modeling of surface materials appearance using these nontrivial models. These general mathematical models, applicable also in wide areas of texture modeling outside surface materials modeling, allow ideal visual verification using synthesis of the corresponding measured data spaces, contrary to standard discriminative models. The integral part of the thesis is simultaneously the extensive benchmarking of the achieved results. The resulting methods are verified on the proposed benchmark tests and the state-of-the-art BTF measurements acquired on the state-of-the-art ÚTIA gonioreflectometer.

This assumes not only to develop several novel multidimensional models from the Markovian family, but also to develop a corresponding parameter estimation and synthesis methods allowing to reconstruct the entire BTF texture data space from limited measured data. The thesis contains several novel Markovian image / BTF models, mainly a multi-spectral simultaneous auto-regressive model, multi-spectral Markov random field model, pseudo Markov random field model, moving average model, extended moving average model, compound BTF model, modified compound BTF model. The thesis contains also an anisotropic BRDF model and two novel dynamic texture models. These novel results represent the state-of-the-art models for several texture classes and expand current limited results published in the image modeling area.

A significant part of the work was also the software developed to model these sophisticated models and to visualize intermediate data and final results.

Finally, the thesis presents two criteria for texture spectral quality evaluation potentially applicable for texture recognition.

Ing.. Michal Havlíček has been working in the Pattern Recognition department of ÚTIA since October 2010 studying the multidimensional Markovian image models and their application surface materials modeling. The candidate has learned this demanding research subject and has successfully contributed into solution of two Czech Science Foundation grants 102/08/0593, 14-10911S. His research resulted in 14 publications - 7 international conference papers, 2 impacted journal papers, 5 student's workshops papers, and another impacted journal paper was submitted and it is currently under review.

Besides mentioned theoretical results the candidate has learned a basic knowledge from the computer vision, computer graphics area and did some useful experimental work here as well.

The results of Michal Havlíček summarized in the thesis open new research possibilities for further advances in BTF material representation modeling and dynamic texture modeling and recognition area.

Altogether I can evaluate Ing. Michal Havlíček as diligently working researcher. These results gained him also a working contract in the institute.

I do recommend the thesis for presentation with the aim of receiving the Degree of Ph.D.

Praha, 28th May 2018

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