MODERN POSSIBILITIES OF IMAGE VIEWING PROCESSESES – INDUSTRIAL'S AND UNIVERSITY'S APPLICATIONS

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Abstract: This paper provides an overview of some advanced modern industrial's and educational's applications of image viewing processes such as simulators, video inspection systems, robotics crawlers, observations by using light and electron microscopy etc. In general, these techniques have found application in teaching and training processes and also for the detection, characterization and sizing determination of cracks and other imperfections whether inherent, processing or service induced. Some possilities of application of image viewing processes of professional firms and specialised laboratories oriented to check of quality of material (structure), technologies (welding, heat treatment etc.) are presented. The topic connection form of those laboratories is network. Some author's experiences of Special laboratory of light microscopy from the field of metallographic observations and their interpretation in teaching/training processes and networking collaboration are also presented.

1. Introduction

This article presents in very compact form:

- levels of image viewing processing using for real objects from real world environment and objects of virtual reality,
- levels and possibilities of using image viewing processing for real direct observations in laboratories,
- that can be successfully used in professional work of companies and research institutes and in education process on universities.

Final result is collaboration in laboratory network, creation of expert laboratories and virtual laboratories able to support various type of education.

Computer based training (CBT) is modern "individually oriented" method of learning, greatly reducing training time and expenses. Different CBT tools can be configured according to customer requirements. **Multimedia classrooms** make use of the latest multimedia technologies and can be connected to other training systems, such as simulation systems, training observation, briefing/debriefing or post action review. **Multimedia CBT classroom** can also include a training task planning systems as well as an evaluation system with record / playback function to increase the training efficiency. But for real life application we suppose using other technologies of image viewing processes (such as observation that uses waves from visible and also invisible part of electromagnetic spectrum) so that we are able to project real objects on PC screen or laboratory equipments display [1].

2. Image projection of imaginary world by using virtual reality

Image generators are mainly based on PC software for various types of database visualization systems. Their features are usually nonlinear distortion, many types of animations and effects; environmental effects such as hydrogen influence; the control of moving models and sub-models such as grains or precipitates; animation of interactions physical model with simulated material structure etc.

Realistic 3-D moving models have high quality standard, usually optimised for visualization quality. The structured models from model libraries allow simple structure-generation using modern scene image generators [1]. Image generators and 3-D moving models are the basic elements for creation and use of any application in virtual reality.

Next part of the article briefly describes methodology of real world objects projection [2].

3. Image projection of real world by using electrons and visible light spectrum - electron and optical microscopy

During the work on light microscope the image of studied object can be obtain not only typical way (so called projection in white field) but also in dark field, polarised light, monochromatic or UV light, Moiré interferometry etc. If light microscope magnification is not sufficient electron microscopy technique are used (for example secondary emitted electrons, Auger spectroscopy, X-Y modulation etc).

Next picture presents nanofibre of carbon observed by electron microscopy.

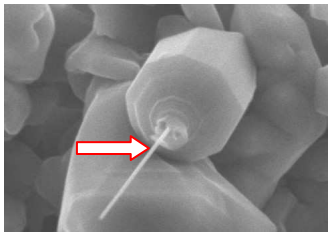

Fig. 1
Nanofibre of carbon as example of
image viewing process by using electron microscopy [9]

4. Image projection of real world by using Inspection systems

The (video) inspection systems were designed to assist the law enforcement and security services in covert operations and surveillance applications.

The systems are represented by borescopes, fibrescopes, so called snake eyes etc.

These systems sometimes include an ultra-quiet operational mode and the ability to see in low-light environments.

Typical applications of these inspection systems are law enforcement operations (SWAT operations, covert operations, border patrol, drug interdiction, etc.), aviation (commercial and military, OEM, MRO and Business Aviation), power (nuclear, fossil, combustion turbine, combined-cycle, hydro and wind), process (refining, offshore, chemical, distribution/transportation, food, ultra-pure and water treatment), manufacturing, shipping etc [3,4].

5 Image projection of real world by using Robotics crawlers

Valued throughout the world for their rugged versatility, robotics crawlers have distinctive modular design. The camera, control unit, cable reel, and lighting are interchangeable on various models. For example the ROVVER's system features a unique modular design and lighting for maximum adaptability. It provides full-directional viewing in a horizontal pipe or line with its pan-and-tilt or forward-viewing video camera. Both cameras have remote adjustable focus for a clear view at all times.

Fig. 2
Robotics crawlers
with ability to clean the pipes [7]

They have the ability to pass through restricted pipe, large offsets, and protruding pipe taps.

6. Laboratory of Special Light Microscopy with equipment for image processing in Material Science – segment of LCIT

Specialised laboratory of light microscopy for metallographic observations is usually equipped with the light microscope and professional digital compact camera OLYMPUS CAMEDIA C-5050Z with resolution 5,1 Mega pixels a software for picture processing Quick PHOTO Pro [5].

PDC camera OLYMPUS CAMEDIA C-5050Z is connected by special tele-extension adapter to the third eye of light microscope by fine screw [5,6].

To work under PC remote control the internal program of PDC camera must be switched off. **Software Quick PHOTO Pro** allows to manage (by keyboard and mouse) most of the important functions of PDC camera – zoom, mode of work (= microscope or macro), manual or automatic focussing method, ISO sensitivity (= 100, 200, 400 or auto), format of saved graphical file (TIFF, SHQ, HQ) and grabbing of picture to **video-grabber card**. Before the image program was used in daily conditions, calibration procedure of scale marker for each magnification value (50x, 100x, 200x, 400x etc.) had been done. In professional version of Quick PHOTO Pro software the measure of distance(s) between two points is allowed (for example thickness of (surface) layer(s), size of particle(s), distribution of particles, thickness of lamellas etc). If PDC camera is disconnected from microscope it can work in regime of super macro (photo from distance about 3 cm from surface), **panorama 360º picture**, remote control on **long distance** by infrared light **control**. Obtaining of separate frames series in **high speed sequence** as well as recording movies in mov format is also possible.

In Specialized laboratory of light microscopy, metalographical analyse of rotary blades aeroplane engine DV-2 was focused on study of structural changes in surface and near-surface Al-Si layer (its homogenity and uniformity), and changes of morphological phases of base material.

Fractographical observation of tyre (which is very known product of our everyday life) during its exploitation and degradation is presented in next picture.

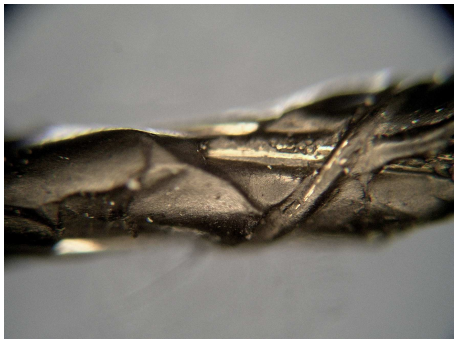

Fig. 3
Study of internal degradation tyre during its exploitation
magnification: 50x
[Várkoly, L. – Kučma, A. Specialized laboratory of light microscopy]

7. Conclusion

The most important and decisive aspect of here described techniques is their simplicity and almost universal ability to be applied for education in all types of Faculties. Technologies presented in the article and innovative's products are used to streamline the inspection process in many industries and human activities where safety, security and accuracy are the highest concern. Such cases are aviation, power generation, processing, manufacturing or even surgery, law enforcement and public infrastructure. Therefore we are supposed to educate our student in all these areas [7,8,9].

Notice:

This article offers brief information about Specialised Laboratory of Light Microscopy **headed by Prof.Várkoly. The laboratory is a** member of International laboratories network LCIT **(Life Cycle Integrated Testing).**

During conference lecture other obtained photos will be presented as results of the

Specialised Laboratory of Light Microscopy activities, financially supported by Agency of the Ministry of Education of Slovak republic "Establishing of visualisation centre for introducing of e-learning technology **".**

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