Optics and image processing research by the Belarusian team

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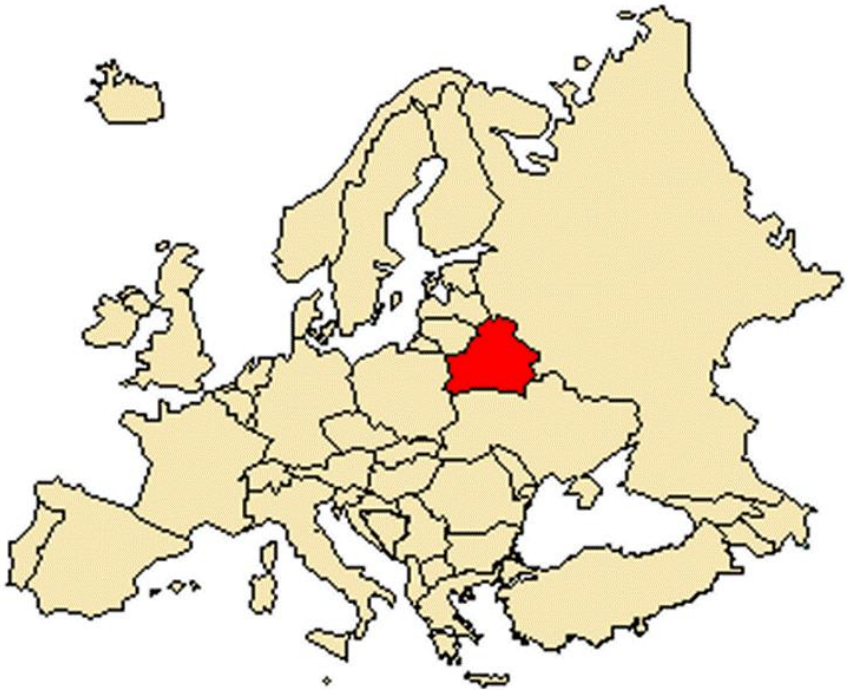
We are from Belarus



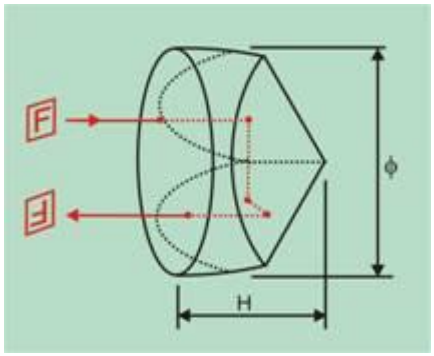
As definition (European Commission C(2007)562 of 26.02.07). Republic Belarus belongs to International cooperation partner countries (and this country is also part of the European Neighborhood Policy)

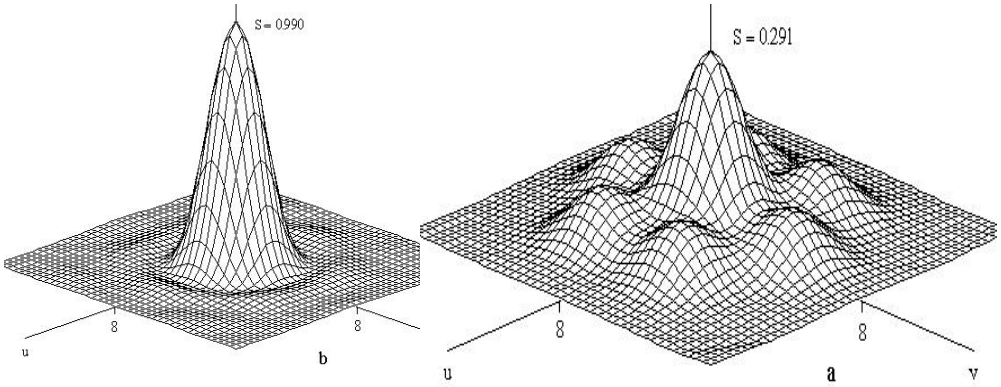
Our Manpower

- Our team worked at the Institute of Applied Optics of the National Academy of Sciences of Belarus in the Laboratory by Optical Means of Information before 2005 (when Institute was joined to the Institute of Technology of Metals).
- At present our team (5 researchers) consists of
  - 2 Doctors in Optics.
  - 1 Doctor in Computer Engineering.
  - 2 Engineers (they also work toward PhD).
- We also engage in projects researchers from others Institutes and Universities (up to 6 PhD, 3 Dr. Sc. and Students).
- In the old times (1985-1993) in the Laboratory of the Institute of Applied Optics worked up to 30 peoples.

Recent Project: Diffraction technique for testing of quality of cube-corner retroreflectors

Up to date we have performed:
- theoretical studies of solving of the direct and inverse problems of diffraction by a non-ideal cube-corner retroreflector of a tetrahedron type;
- numerical simulation of diffraction fields of cube-corner retroreflector of different kind including the metallized and total internal reflection ones and also those having dielectric coating of working facets;
- development of optimized cube-corner retroreflectors with extremely low (diffraction) divergence of a reflected wave:

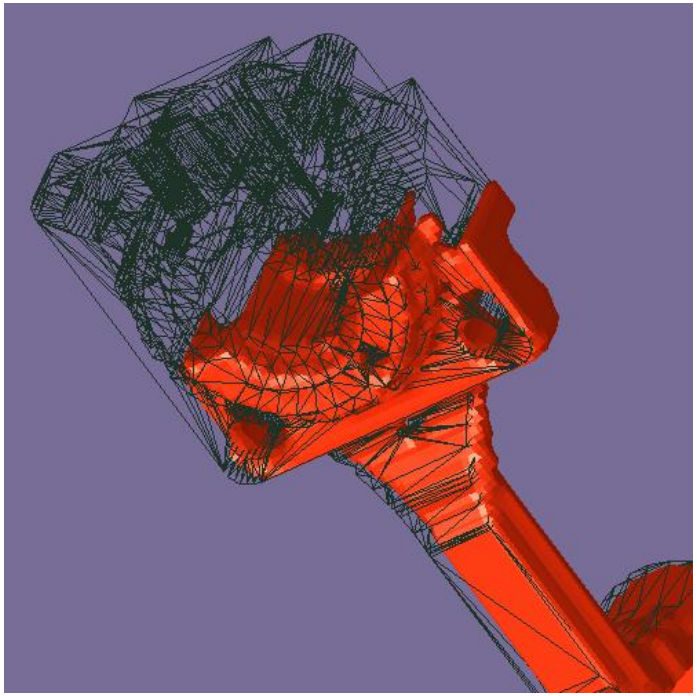




Normalized spatial intensity distributions (u and v are dimensionless coordinates) in patterns of diffraction of unpolarized light by a usual ideal total internal reflection retroreflector (a) and the optimized reflector of the same type having extremely low (diffractional) divergence of a reflected wave (b).

Recent Project: 3D Reconstruction for modelling of Al casting processes (For Republic Korea)

- There was developed set-up, methods and software for modelling



Hwang H. Y., J.-K. Choi, Marukovich E. I., Branovitsky A.M. Zakharov I.L.
Three-dimensional modelling and simulation of high pressure die-casting processes for AlSi alloys // Proc. of World Foundry Congress, WCF06, 4-6 June, Harrogate, UK. 2006.

Recent Project: LED Traffic Light Signals

The standard **incandescent bulb** used in traffic signals lasts just 12-18 months.

LED light fittings are easier to see in daylight and poor weather (sunny, fog) conditions, use just in 5-10 times less power, and last well over 5 years.

- We developed such heads in accodnancy to Belarusian Specifications on brightness, diagramm, wawelengs and others.
- And developed lights fit instead bulb head without whole signal replacement.

Main directions of research

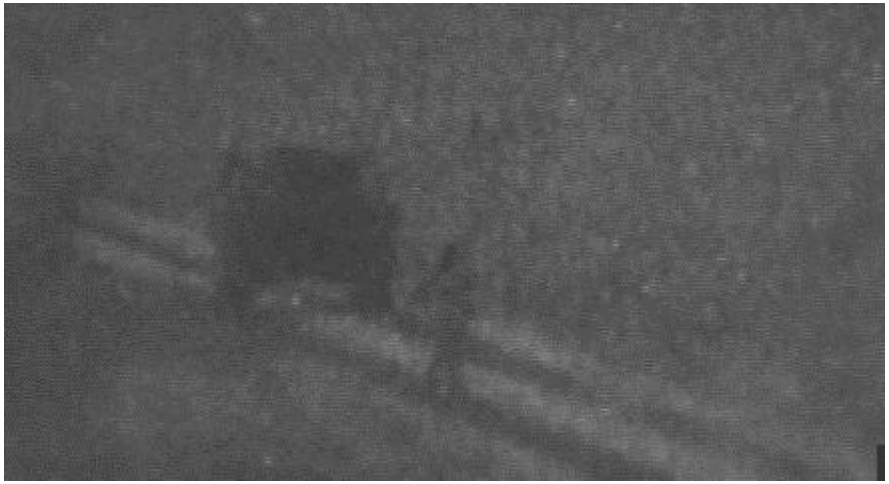
- Methods of image processing and pattern recognition (including novel method of image restoration and super-resolution)
- Optical systems performances (polarization, diffraction *etc*) theoretical evaluation and measurements
- Theory and methodologies of transfer functions (Point Spread Function, Optical Transfer Function *etc*) calculation and measurement
- Light scattering
- And others

Current Projects

- 4 main projects in Optics and Image Processing fields
- Several projects of fundamental research and Regional Program

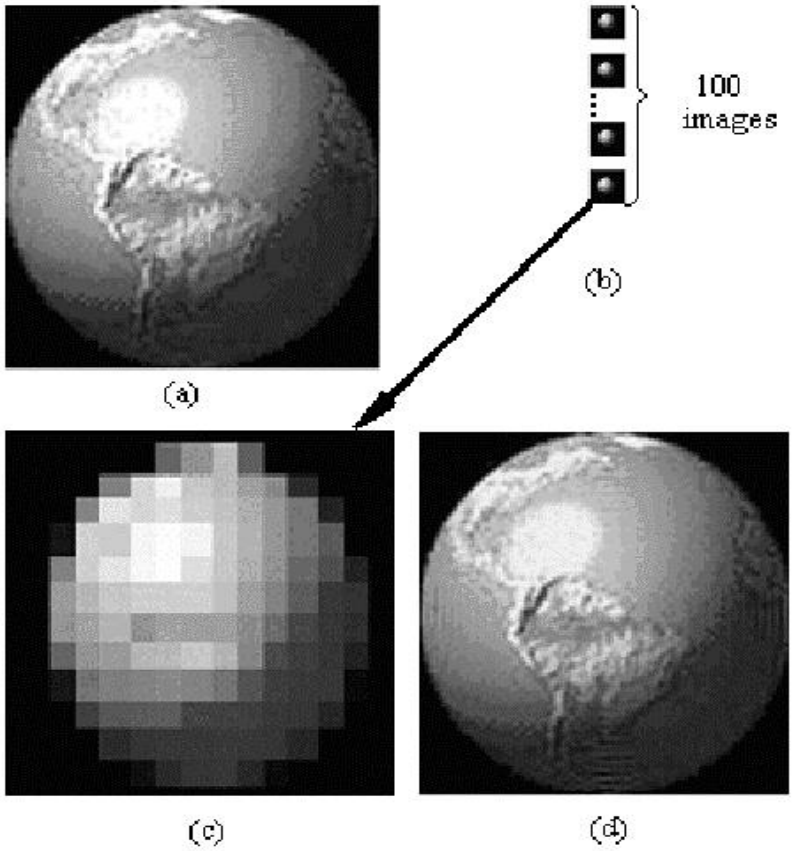
Current Project

"Image processing methods, software and hardware for High-resolution Vision Systems", 2006-2009, Program "OptoTechnologies", Belarus



Real-time image processing

Current Project "Development software for super-resolution image restoration" Space Program Between Russia and Belarus, 2006-2007



Result of restoration.

(a) - initial image;

(b)-images received from (a) by shift, blur and sampling;

(c)- enlarged image (b);

(d) – reconstructed from 100 images (b).

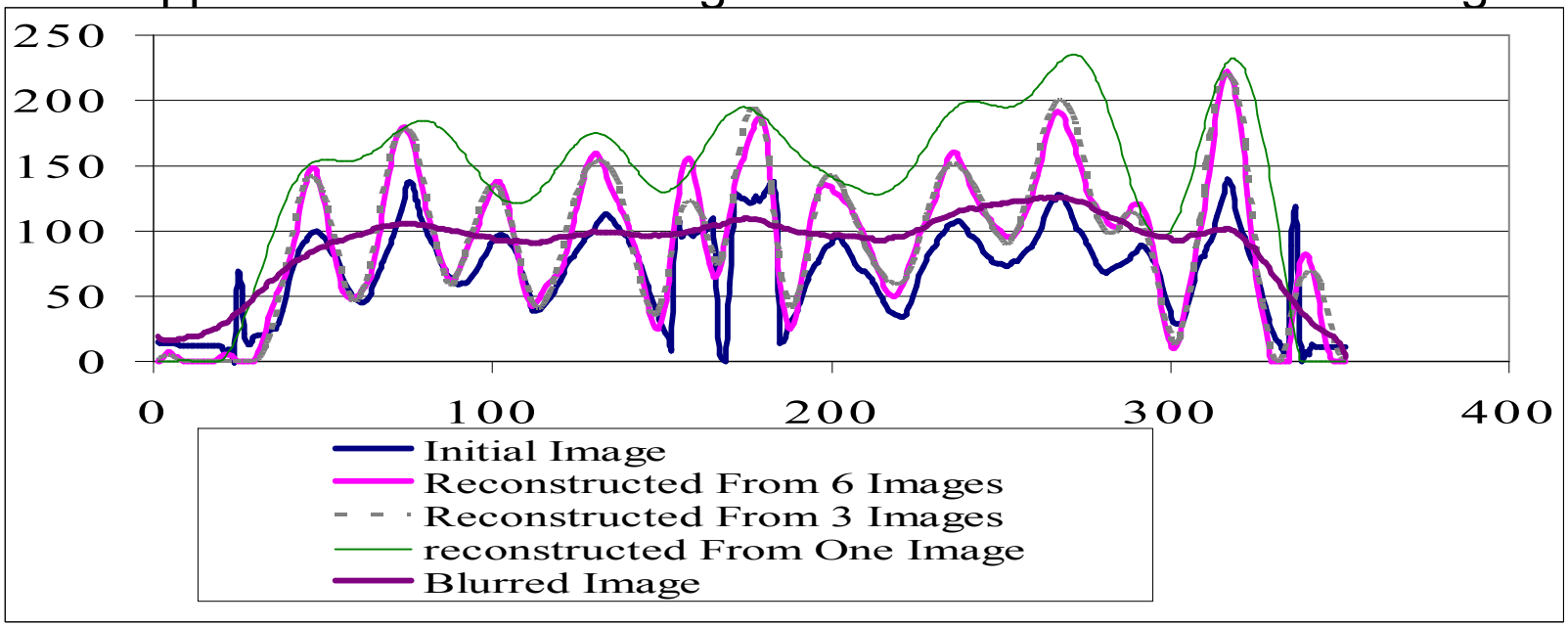
Current Project

"Development of systems for technical vision with high speed fragmentary registering of images in VIS and IR range up to 800 Hz, and for the full format matrix registering with inner and outer accumulation with a sensitivity of 0.003 – 0.005K",

This is a collaborative project with Institute of Automatics and Electrometric of Siberian Branch of Russian Academy of Sciences, 2006-2009

Current Project: Fundamental research, 2006-2008

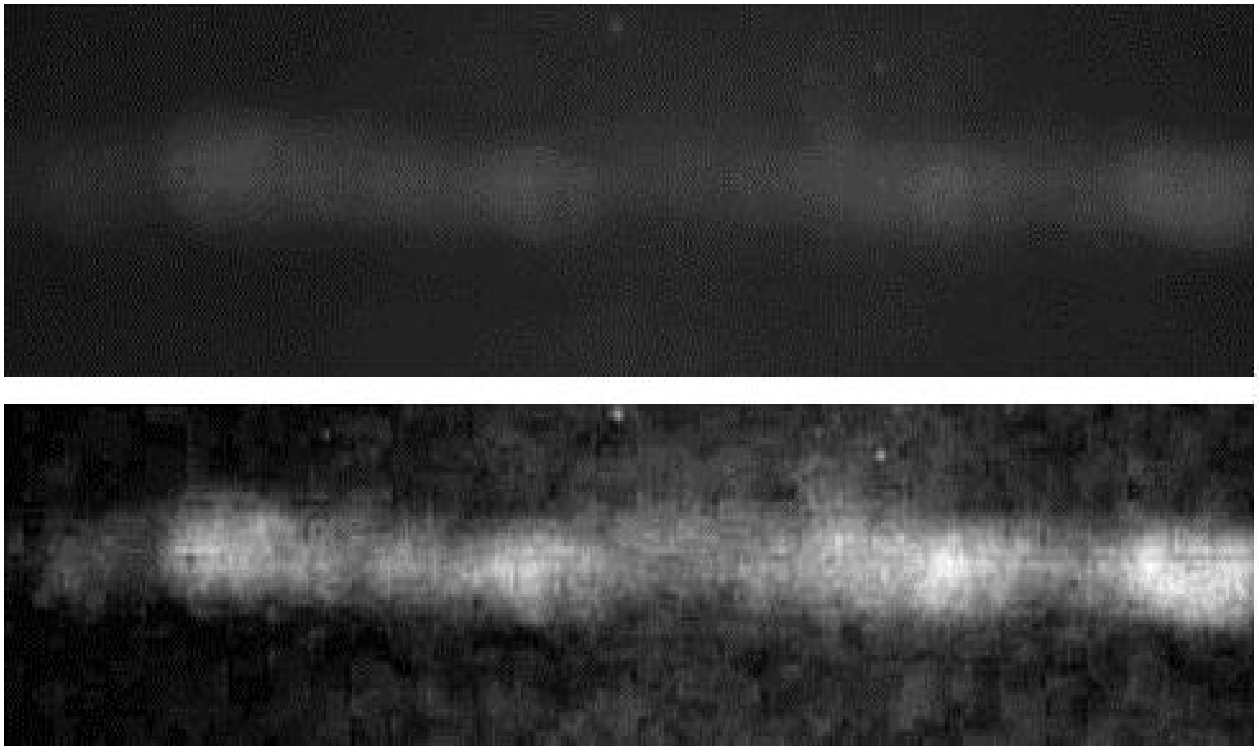
Informational evaluation of quality linear measurements by apparatus of medical diagnosis and non-destructive testing



Dovnar D., Zakharov I. Transmission of information about high spatial frequencies of optical object on its low frequencies for limited channel capacity of optoelectronics system// SPIE. –Vol. 5948. – 2005. – P. 567-576.

Current Projects: Others

Regional project **Nondestructive testing of welding quality**



We have prepared and carried out international projects proposals (INTAS, NATO, etc) with our **Collaborators**:

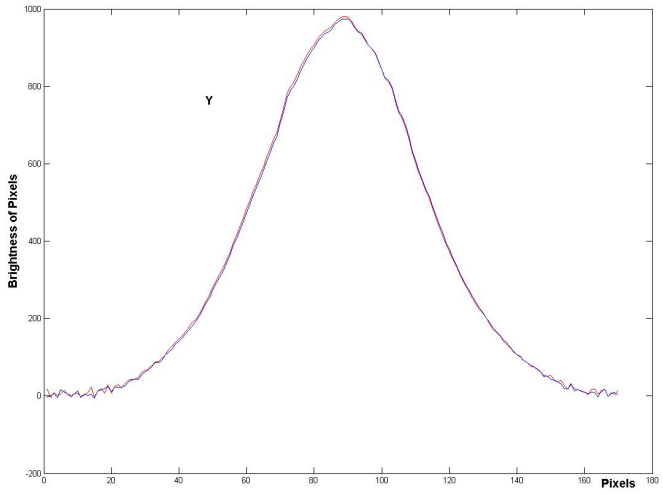
- University Granada (Spain);
- National University of Ireland
- “FotoNation” Inc. (Ireland)
- Research Institutes in Belarus and Russia

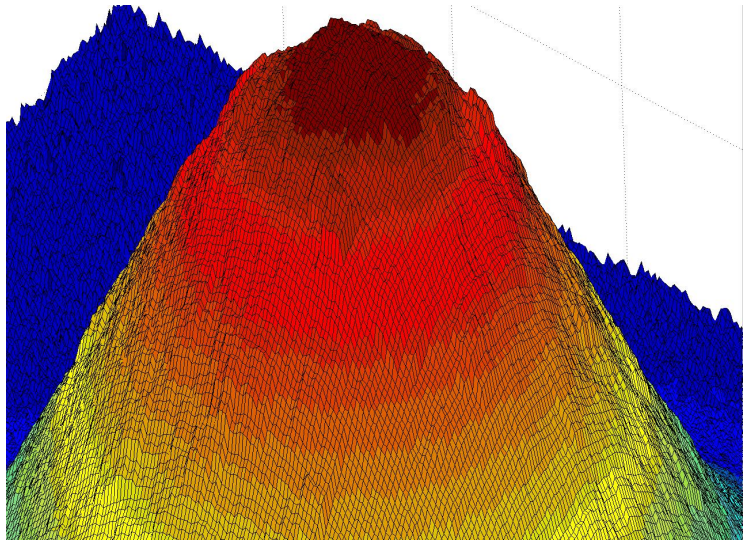
(5 Institutes)

- Korean Institute of Industrial Technologies

Cooperation with University of Applied Studies and Research, Wernigerode

High precision laser beam measurement





For research work in Optics there is good experimental equipment in this University

What we propose for autooptics

- To conduct research, which is in fields of **our experience**
- Development of **Driver Assistance Systems** (Intelligent navigator) for road signs and traffic lights recognition
- **Night vision system** offers infrared-based possibilities to increase visibility in the dark and to visually highlight lane barriers and pedestrians
- A radar or laser (imaging) sensor at the front of vehicle to determine the distance and/or the relative velocity towards the object (also in the bad conditions, as fog etc.).

Driver Assistance Systems

A system will be developed with FotoNation Inc. (Ireland) who is experienced in the field of image processing and pattern recognition (Scene Analysis, High Dynamic Range Image Analysis). FotoNation Inc. is holder of (EU and the USA) patents in the required fields. And their experience makes it possible to fast development whole system.

The system consists of

- *Video camera*
- *Video processor (PC) with Image processing board*
- *Display*

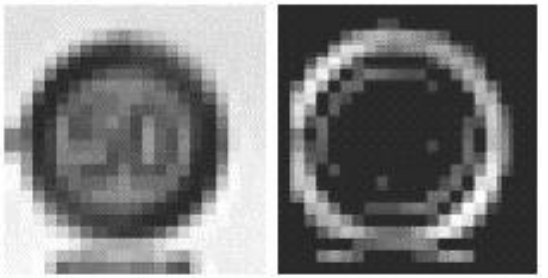
+

Micro-Processor

Driver Assistance Systems

E.g. for sign recognition

Detect candidate signs for recognition



Screen candidates by using edge information

Extract characters and symbols 50
Identify sign
Display information

In this field there are EU projects (e.g. DRIVSCO, MCCOOP),
but our system will be better and cheaper!

The scheme of collaboration

- In the framework of EU FP-7 program (if it is possible)
- Through our collaborators
- Another way (e.g. visits of researchers)

Thank you
for attention