



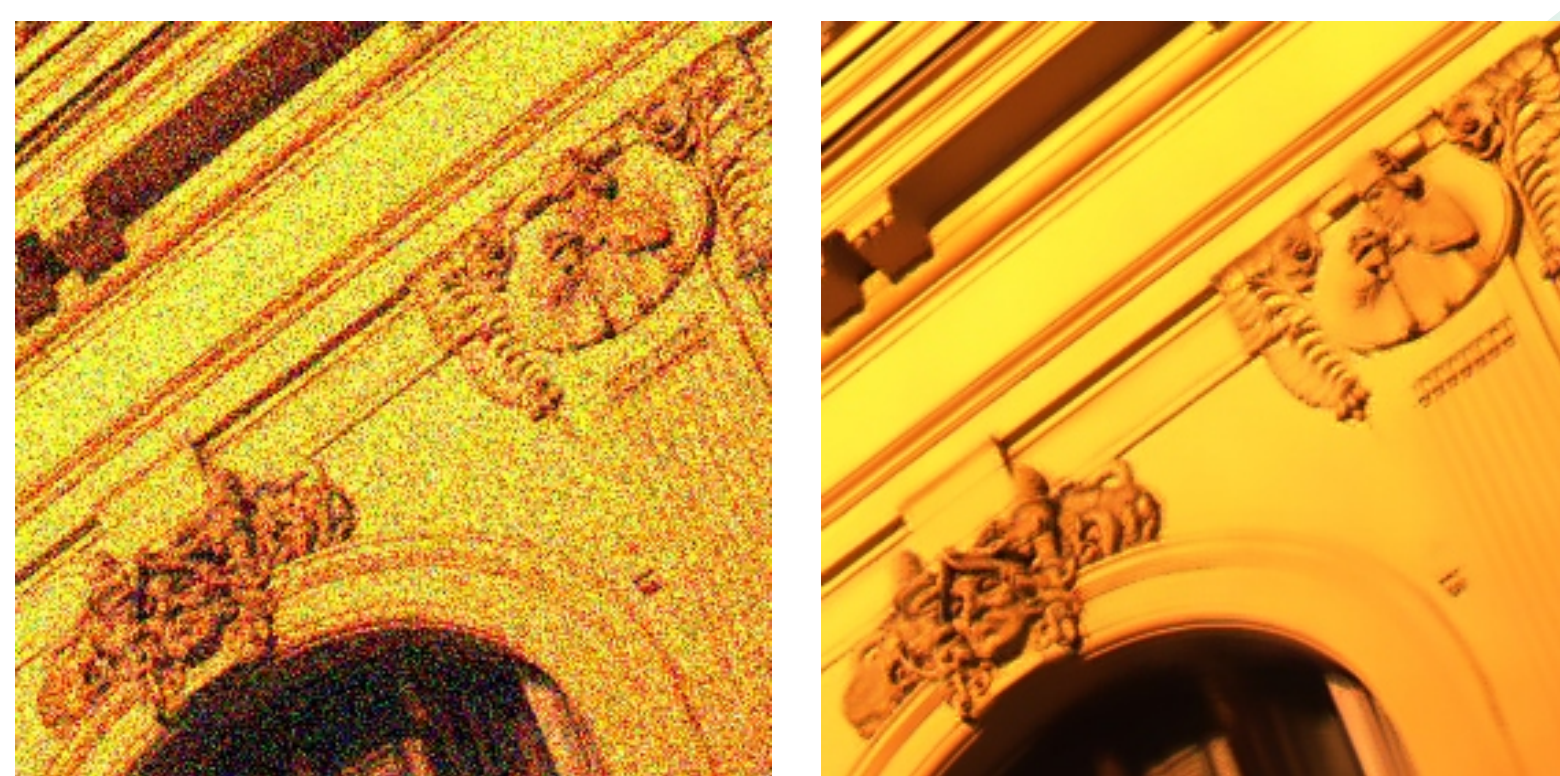
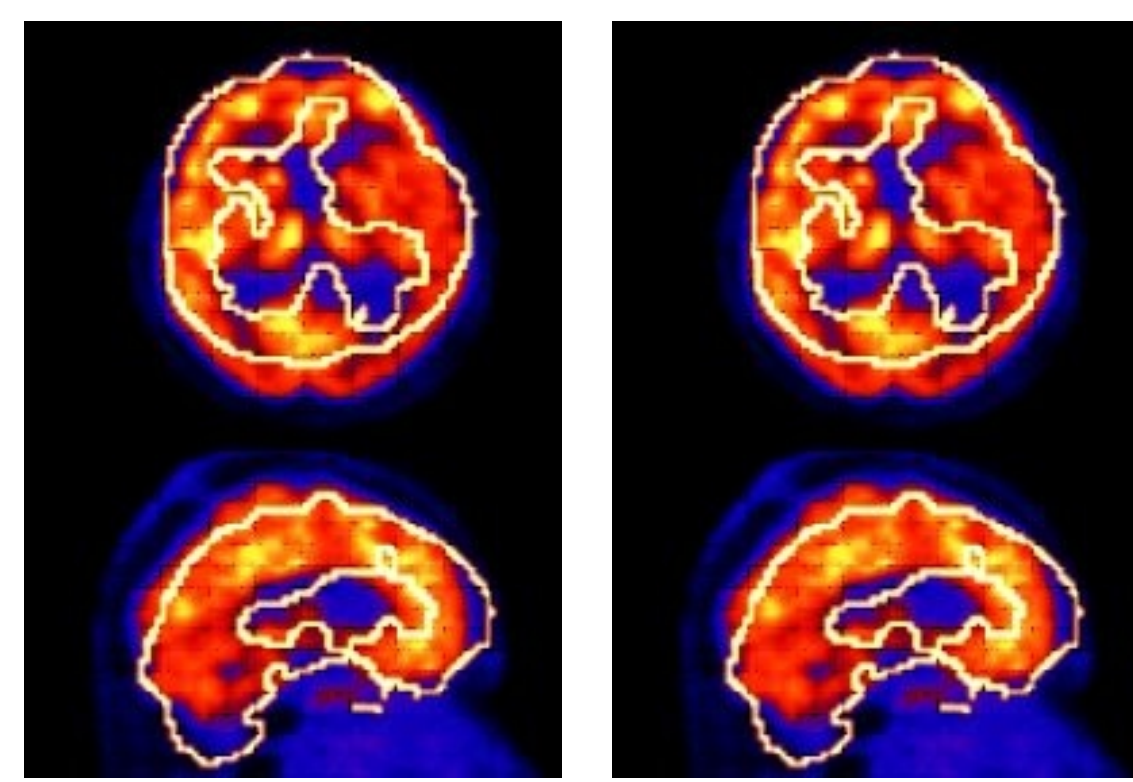
Our team is from the **Image processing department** in the Institute of Information Theory and Automation (UTIA). UTIA is a public non-university research institution, which belongs to the Academy of Sciences of the Czech Republic. UTIA's scope is fundamental and applied research in computer science, signal and image processing, pattern recognition, system science, and control theory. Tight cooperation exists between the institute and several universities, such as Charles University in Prague, Czech Technical University, University of West Bohemia, to name a few. We give courses at the universities, educate their Master and PhD students, supervise their theses, and have with them common projects.

Publication:
Šroubek F., Cristóbal G., Flusser J.: A Unified Approach to Superresolution and Multichannel Blind Deconvolution, IEEE Transactions on Image Processing vol.16, 9 (2007)

Funding:
Czech and Spanish national grants, NATO grant, collaboration with the Institute of Optics, CSIC, Spain. International Patent (WO/2007/042596), MATLAB toolbox (BSR).

Resolution Enhancement

Resolution enhancement or so-called **super-resolution** is a process of combining a sequence of low-resolution images or video frames in order to produce a high-resolution image or video. The novelty of our approach is in combining superresolution with image deblurring and denoising. Our algorithm performs automatic sub-pixel registration by calculating blurs in the high-resolution grid. Alternating minimization scheme is used to find a **maximum a posteriori** (MAP) estimator of the high-resolution image and blurs.

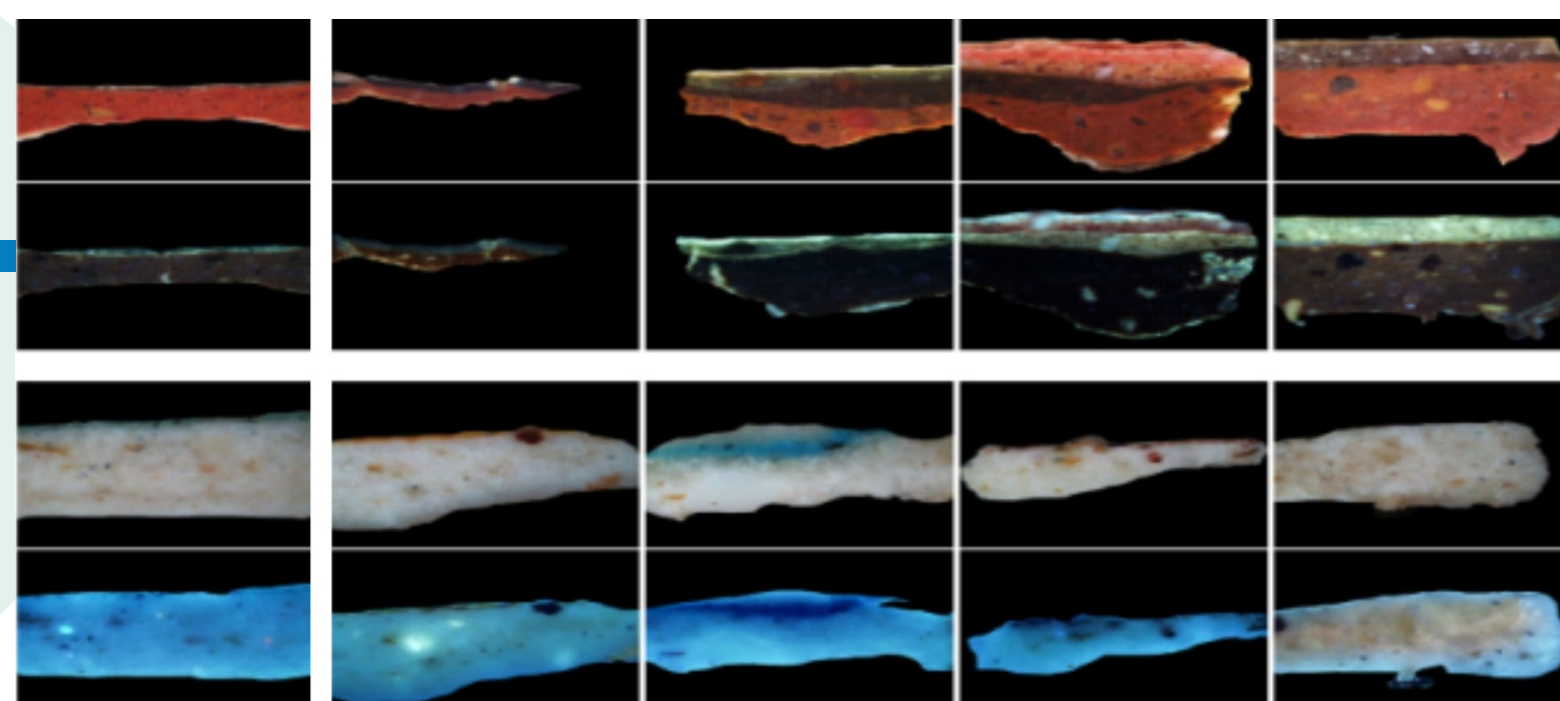


Publication:
Beneš M., Zitová B., Flusser J., Hradilová J., Hradil D.: The Image Processing System for Art Specimens: Nephelē, Proceedings of 14th European Signal Processing Conference EUSIPCO 2006.

Funding:
National grants, collaboration with Czech Academy of Arts, private companies

Content based image retrieval

Our experience with object recognition was used during creation of image databases with search capability (content based image retrieval) based on image similarities. Nephelē system is oriented to the culture heritage area, using the multimodal input data (visible, UV, and scanning electron microscope images). PIRIS is a CBIR application for image forgery detection (everyday photos).

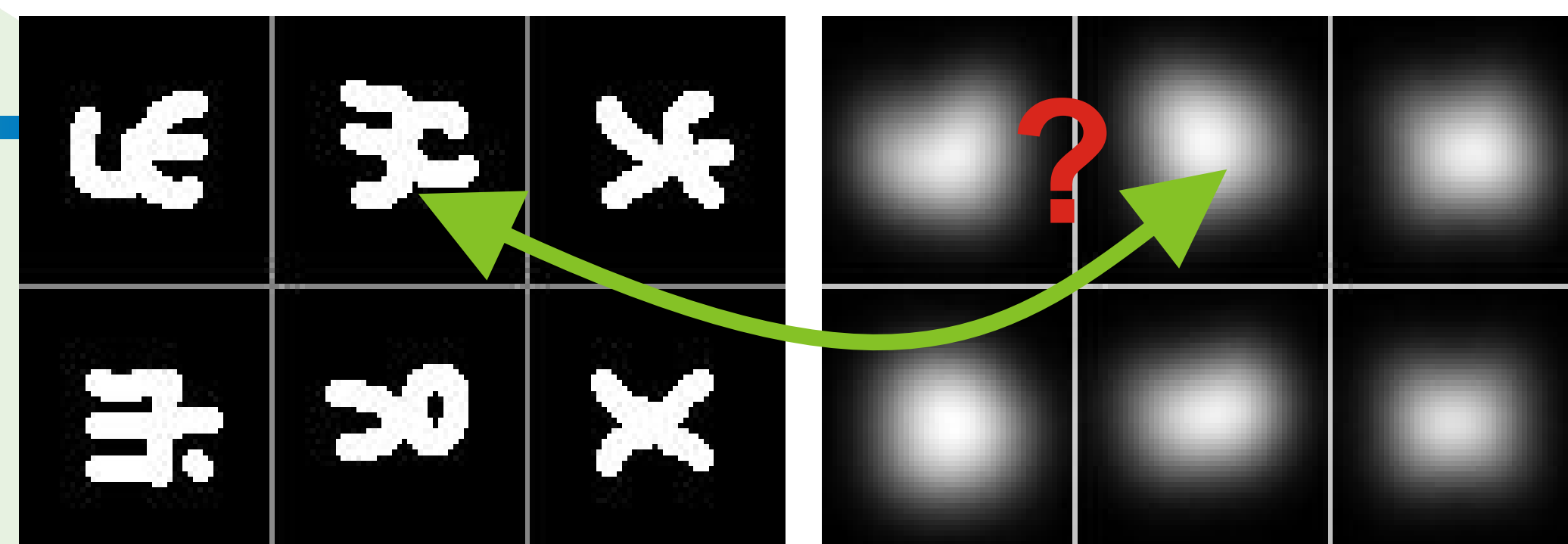


Publication:
Flusser J., Boldyš J., Zitová B.: Moment forms invariant to rotation and blur in arbitrary number of dimensions. IEEE Transactions on Pattern Analysis and Machine Intelligence vol.25, 2 (2003)

Funding:
National grants.

Object recognition

Our department has been involved in the research of object descriptors based on moment theory for many years. They are the fundamental elements for many image processing tasks - object classification, image registration, image retrieval, to name a few. The novelty of the proposed descriptors is their applicability to both 2D and 3D data, degraded by radiometrical (blurring) as well as geometrical degradations.



Publications:
Goshtasby A., Flusser J., Šroubek F., Zitová B.: Tutorial: Survey and Recent Advances in Image Registration and Fusion, Abstracts Book of IEEE Compute Society Conference on Computer Vision and Pattern Recognition, 2008

Funding:
collaboration with a Czech hospital.

Image Fusion

The goal of image fusion is to integrate **multisensor**, **multitemporal**, and **multiview** information into a new image containing information of which quality could not be achieved otherwise. A wide range of application areas (remote sensing, astronomy, and medical imaging) utilizes image fusion. We have developed several algorithms for fusion of structural (CT, MRI) and functional medical data (PET).



Publication:
Zitová B., Flusser J.: Image registration methods: a survey, Image and Vision Computing vol.21, 11 (2003)

Funding:
National grants, collaboration with Czech Academy of Arts

Image registration

For multisource analysis the image registration is a necessary preliminary step, which puts data into geometrical alignment. We have been working with 2D and 3D data both with global and local geometric differences, obtained either in the same modality or acquired in different modalities. Recently, we developed a new algorithm for rotated and translated 3D images based on phase correlation, especially applicable for medical images.

Publication:
Kašpar R., Zitová B.: Weighted thin-plate spline image denoising. Pattern Recognition, vol. 36, 12 (2003)

Funding:
National grants, collaboration with the Institute of Photonics and Electronics, AS CR.

Noise reduction

Noise reduction is the process of removing noise from an image. The basic requirement is preserving as much detail as possible. The methods developed at our department are based on total variation regularization and thin plate splines.

Publication:
Šorel M., Flusser J.: Space-variant Restoration of Images Degraded by Camera Motion Blur. IEEE Transaction on Image Processing, vol. 17, 2 (2008)

Funding:
Czech and Spanish national grants, NATO grant, collaboration with the Institute of Optics, CSIC, Spain. MATLAB toolbox (MBD).

Image deblurring

Image deblurring techniques find applications in a number of real-world problems from astronomy to medical imaging. In our department, we proposed several state-of-the-art methods, working with either a homogenous blur or a blur that varies throughout the image. As a rule, the methods fuse information from several images. The key idea behind them is minimization of functionals that fit physical model to data and enforce local statistics typical for sharp images.

Publication:
B. Mahdian and S. Saic: Blind Authentication Using Periodic Properties of Interpolation. IEEE Transactions on Information Forensics and Security, vol. 3, 3 (2008)

Funding:
National grants, collaboration with the Czech Police Department

Image analysis

Assessments of image quality or image authenticity are becoming more important in imaging and forensic applications. We have developed **measures** that evaluate amount of blur in images. Several algorithms capable of detecting **traces of tampering** in digital images were recently developed in our department. The methods detect traces of resampling, near-duplicated regions and noise non-consistencies.