TRANSILANIA University, Brașov, România
Faculty of Electrical Engineering and Computer Science

Department of Electronics and Computers

MIV² Research Laboratory
MIV Imaging Venture http://www.miv.ro
Machine Intelligence and Vision http://miv.unitbv.ro

Scientific interest and domains of expertise	Keywords
algorithm and data structures computational and artificial intelligence color image processing and analysis parallel algorithms and architectures, GPU programming parallel calculus for bioinformatics	**fractal geometry, mathematical morphology, texture analysis, image segmentation, MPEG, informational energy, SVM, GPU, CUDA, OpenCL**

Group profile

The MIV Imaging Venture laboratory was created in 2006 by Mihai Ivanovici, and in 2010 the MIV² laboratory was born by merging with the Machine Intelligence and Vision team, leaded by professor Răzvan Andonie. MIV² has its roots in the former image processing research group within the Institute of Computing Techniques (ITC), Brașov. Nowadays the MIV² laboratory is integrated in the C13 research center called ``Electronic Embedded Systems and Advanced Communications" within the Research and Development Institute of the Transilvania University Brașov. The MIV² laboratory collaborates with:

- LAPI (Image Processing and Analysis Laboratory), Politehnica University, Bucharest
- XLIM-SIC (Signals, Images, Communications Laboratory), Futuroscope, Poitiers, France
- GRIN (GRaphics and INteractive Multimedia Laboratory), ARTEMIS Department, Institute Mines-Télécom, Evry, France
- CERN (European Organization for Nuclear Research), Geneva, Switzerland

Team members


Prof.dr.mat. Răzvan Andonie


Prof. dr. ing. Gheorghe Toacșe

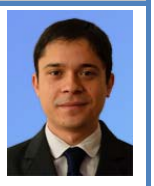

Conf. dr. ing. Mihai Ivanovici


Ș.l. dr. ing. Angel Cațaron


Dr. ing. Honorius Gâlmeanu


Drd. ing. Istvan Lorentz


Drd. ing. Alexandru Căliman


Drd. ing. Radu Coliban

Professor Răzvan Andonie obtained in 1984 his PhD title in mathematics and computers science from Bucharest University under the supervision of Acad. Solomon Marcus. Răzvan Andonie is a PhD supervisor in computers and information technology and he is active in computational intelligence, machine learning, parallel and distributed computing and computational biochemistry.

Assistant professor Mihai Ivanovici obtained in 2006 his PhD title in electronics and telecommunications from Politehnica University Bucharest, based on his research activity at CERN, Geneva, under the supervision of prof. Vasile Buzuloiu. His domains of interest include texture analysis, image segmentation and biomedical image processing and analysis.

Lecturer Angel Cațaron obtained his PhD title in 2004 from Politehnica University Bucharest and the domains of interest are data mining and computational intelligence.
Honorius Gâlmeanu is a software engineer at Siemens România and associated lecturer at Transilvania University. He obtained in 2008 his PhD title from the same university. His domains of interest are data mining and bioinformatics, especially sequence alignment.

Research portfolio

Fractal models for color texture analysis allow for color fractal texture generation with known characteristics, as well as for the analysis of color texture complexity. The models are accompanied by fractal measures (color fractal dimension, lacunarity) extended to the color domain. The plethora of applications includes: the qualitative study of surfaces, texture classification, image segmentation and indexing.

Color textures of various complexities (CFD = 3.84, 3.25 and 2.23) and corresponding lacunarity curves.

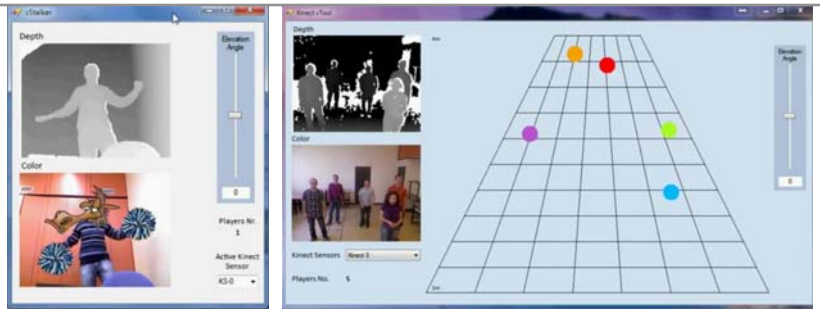
Color image segmentation approaches using texture analysis, fractal geometry and mathematical morphology, active contours, with medical application – dermatological image and computed tomography sequence analysis. Segmentation usually precedes the detection or recognition operations and can be used in any application for region of interest identification based on specific criteria and *a priori* information.

Examples of region of interest segmentation for medical images.

Illumination correction using color checkers, for assisting the dermatologist in the correct evaluation of erythema degree and implicitly the severity of psoriasis lesions. The method can be adapted to a wide spectrum of applications.

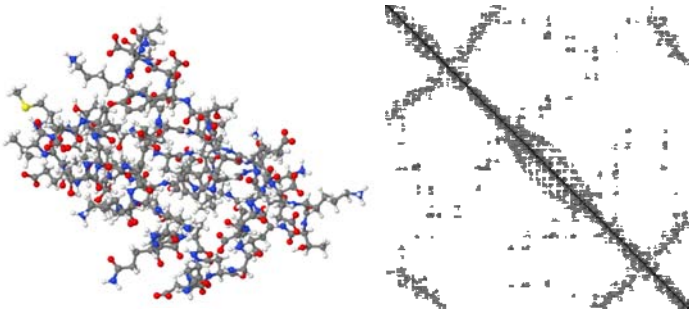
Psoriasis lesion - before and after illumination correction.

N-dimensional camera applications (Microsoft Kinect and Time of Flight cameras) for humanoid animation, video games, movement tracking for one or more persons. The research performed together with the GRIN laboratory, Institute Mines-Télécom, Evry, France lead to a contribution to the MPEG standard: MPEG-V ISO/IEC JTC1/ SC29/WG11 MPEG2012/M26808 – V.A. Nica, M. Ivanovici, M. Preda, ``XML Scheme and Description for Camera Sensor Type", 102th MPEG Meeting, Shanghai, China, 2012. The developed algorithms aim at finding key points in images or video sequences by processing both color and depth information about the analyzed scene.



Screenshots from the humanoid animation and persons' movement tracking applications.

Applications in biochemistry and bioinformatics. We developed various parallel algorithms on multi-core and GPU platforms, in order to determine the 3D structure of proteins based on the inter-atom distances obtained by spectrographic methods. The structure is very important in biochemistry because it determines the biochemical properties of the protein, as well as its interaction with a certain inhibitor.



3D structure of a 2GB1protein and the matrix of inter-atom distances.

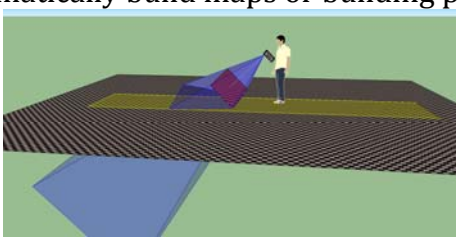
Machine learning paradigms. An original aspect of our research is the usage of Onicescu's informational energy in data mining and machine learning problems. Our focus is on large data sets (*big data*) and small data sets (*small data*). In the case of big data, the learning mechanism have to be computational efficient, while the small data are usually not enough for building an adaptive model. Thus, we address problems of extreme data mining.

Improved SVM model. Support Vector Machine is an efficient model for automatic classification. We improved this online learning model and contributed to its efficient implementation.

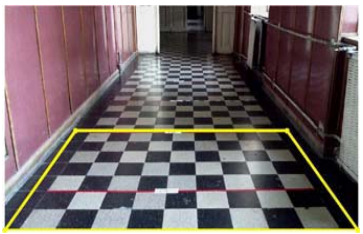
Research projects and contracts

Analysis, Modeling and Simulation Techniques for Imagery, Bioinformatics and Complex Systems (ITEMS) contract POS-DRU/86/1.2/S/61756, 2010-2013. In the context of developing a new curriculum for a research master program, we implemented various algorithms using CUDA C/C++ on NVidia GPUs. The goal was to accelerate existing image processing algorithms and developing new ones, like color diffusion models for active contour-based image segmentation or molecule models for biochemistry applications.

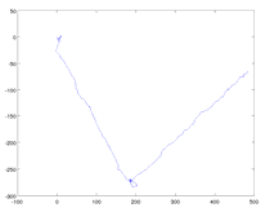
Video odometry algorithms for augmented-reality applications of navigation using mobile devices (contract with S.C. ROUTE 66 S.R.L. Braşov, 2011). Analysing the video signal and the data from various sensors allows us to reconstruct the movement path, in order to automatically build maps or building plans.



Virtual 3D scene



Floor plan identification

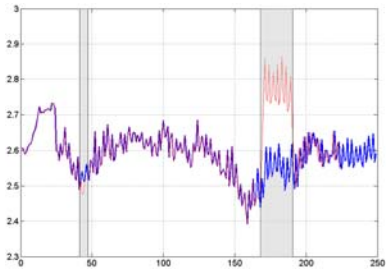


Computed path.

System and methodology for video signal quality assessment for MPEG-4 video streaming applications (contract with S.C. Infinity Design S.R.L. Braşov, 2008). The loss of UDP packets at network level leads to video quality degradation. The proposed system allows correlating the user-perceived quality degradation with the quality of service at network level. It can be used to study the quality of any IP-based digital video transmission for Internet providers or TV studios.


Original video frame


Received video frame (degraded)



Video signal quality over time.

Fuzzy ARTMAP with feature weighting with application in data mining (contract CNCSIS 989/2007). In this project we developed a new classifier which differentiates the input of the system based on its importance or relevance during the classification process. This automatic classification model is based on fuzzy ARTMAP neural networks and a measure derived from the informational energy.

Representative scientific publications

1. R. Andonie, A. Cataron, H. Gâlmeanu, M. Ivanovici, L. Sasu, ``Algoritmi şi Structuri de Date pentru Imagistică şi Bioinformatică. Note de curs", Editura Universităţii Transilvania din Braşov, 2013
2. I. Lorentz, R. Andonie, M. Maliţa, ``An Implementation of Evolutionary Computation Operators in OpenCL", in Intelligent Distributed Computing, Springer-Verlag, Berlin, 2012
3. M. Ivanovici, N. Richard, D. Paulus - "Color Image Segmentation", in Advanced Color Image Processing and Analysis, editor Christine Fernandez-Maloigne, Springer, New York, 2012
4. L. Fabry-Asztalos, I. Lorentz, and R. Andonie, ``Molecular Distance Geometry Optimization using Geometric Build-up and Evolutionary Techniques on GPU'' in Proc. of the IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology, CIBCB'12, (San Diego, CA), 2012
5. R. Andonie, A. Cataron, Z. Gaspar, H. Gâlmeanu, M. Ivanovici, I. Lorentz, L. Sasu, ``Algoritmi şi Structuri de Date. Aplicaţii în Imagistică şi Bioinformatică", Editura Universităţii Transilvania din Braşov, 2012
6. M. Ivanovici, D. Stoica, ``Color Diffusion Model for Active Contours - An Application to Skin Lesion Segmentation", 34th Annual Int. Conf. of the IEEE Engineering in Medicine and Biology Society, San Diego, CA, August 28-September 1, 2012
7. M. Ivanovici, N. Richard, ``The Colour Fractal Dimension of Colour Fractal Images", IEEE Transactions on Image Processing, vol. 20, no. 1, pp. 227-35, 2011
8. A. Cataron, R. Andonie, ``Energy Supervised Relevance Neural Gas for Feature Ranking", Neural Processing Letters, vol. 32, pp. 59-73, 2010
9. H. Gâlmeanu, R. Andonie, ``Practical Implementation Issues of an Incremental and Decremental SVM", ICANN 2008, Lecture Notes in Computer Science 5163, pp. 325-335, V. Kurkova et al (eds.), Springer-Verlag, Berlin, 2008

Contact

Assistant professor Mihai Ivanovici	WEB: http://www.miv.ro, http://miv.unitbv.ro
Head of MIV² Laboratory	Tel. / fax: +40 268 475 751
email: mihai.ivanovici@unitbv.ro	Address: room NII10, Politehnicii 1, Braşov 500024