



INSTITUTE OF INFORMATION AND
COMMUNICATION TECHNOLOGIES
BULGARIAN ACADEMY OF SCIENCES



IICT, BAS, Sofia, AComIn proj., and SP&PR dep.

an introduction by D. Dimov

at Computer Vision and Multimedia Lab
University of Pavia
May 20, 2013

5/20/2013

AComIn: Advanced Computing for Innovation

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<http://www.iict.bas.bg/acomin>

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Sofia map: South-East part

Sofia center

BAS official building

BAS main campus



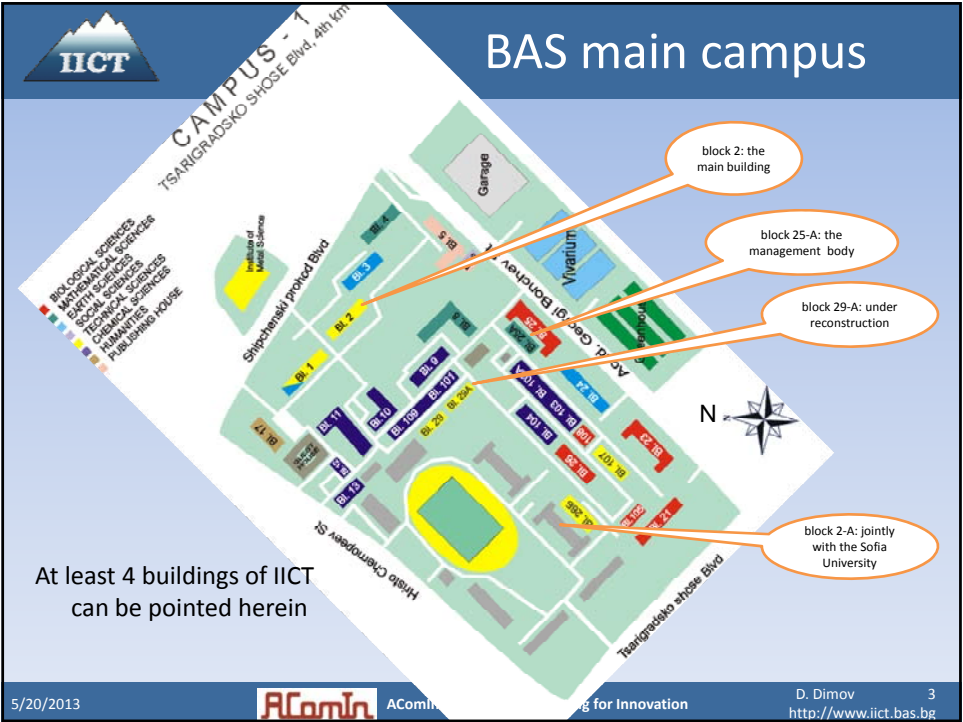
<http://www.bgmaps.com/en/map/sofia>

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IICT-BAS: management body & list of departments

MANAGEMENT BODY

DIRECTOR: **PROF. D.SC. SVETOZAR MARGENOV**
 DEPUTY DIRECTOR: **ASSOC. PROF. KRASSIMIR GEORGIEV**
 DEPUTY DIRECTOR: **ASSOC. PROF. IVAN MUSTAKEROV**
 DEPUTY DIRECTOR: **ASSOC. PROF. ZLATOLILIYA ILICHEVA**
 SCIENTIFIC COUNCIL CHAIRMAN: **PROF. D.SC. IVAN DIMOV**
 SCIENTIFIC SECRETARY: **ASSOC. PROF. GENNADY AGRE**
 CHAIRMAN OF SCIENTISTS GENERAL ASSEMBLY: **ASSOC. PROF. DIMO DIMOV**

DEPARTMENTS

- Computer Networks and Architectures**
Head: [Assoc. Prof. Hristo Turtakov](#)
- Scientific Computations**
Head: [Professor D.Sc. Svetozar Margenov](#)
- Linguistic Modelling**
Head: [Professor D.Sc. Galia Angelova](#)
- Grid Technologies and Applications**
Head: [Assoc. Prof. Emanouil Atanasov](#)
- Modelling and Optimization**
Head: [Assoc. Prof. Vladimir Monov](#)
- Information Processes and Decision Support Systems**
Head: [Assoc. Prof. Ivan Mustakero](#)
- Embedded Intelligent Technologies**
Head: [Assoc. Prof. Dimitar Karastoyanov](#)
- Hierarchical Systems**
Head: [Professor D.Sc. Todor Stoitov](#)

- Parallel Algorithms**
Head: [Professor D.Sc. Ivan Dimov](#)
- Mathematical Methods for Sensor Data Processing**
Head: [Assoc. Prof. Kiril Alexiev](#)
- Information Technologies for Security**
Head: [Assoc. Prof. Todor Tagarev](#)
- Technologies for Knowledge Management and Processing**
Head: [Assoc. Prof. Gennady Agre](#)
- Signal Processing and Pattern Recognition**
Head: [Assoc. Prof. Dimo Dimov](#)
- Intelligent Systems**
Head: [Assoc. Prof. Lyubka Doukouska](#)
- Communication Systems and Services**
Head: [Assoc. Prof. Rumen Andreev](#)

ADMINISTRATIVE AND SPECIALIZED UNITS


- [Inspection Body](#)
- Coordination, Information and Publishing
- Service and Support

- Financial & Accounting Unit
- Human Resources

Last update: April 2013

For more details, please visit <http://www.iict.bas.bg>



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The AComIn Project

Objectives
 Work packages
 Topics in ICT
 SmartLab equipment
 Progress beyond the state of the art
 Employed incoming postdocs
 Opened positions

AComIn: Advanced Computing for Innovation

Funding: FP7 Capacity Programme, Research Potential of Convergence Regions

Call: FP7-REGPOT-2012-2013-1

Duration: 42 months (actually 36, only Evaluation by external experts will run in months 37-42)

Grant Agreement: 316087

Starting Date: 1 October 2012


Host organisation: [Institute of Information and Communication Technologies \(IICT\)](#) Bulgarian Academy of Sciences (BAS)

Coordinator: [Prof. Galia Angelova, Dr.Sc.](#)

Partners:


- [Prof. Asen Asenov - Gold Standard Simulations Ltd.](#) & [University of Glasgow Device Modelling Group](#)
- [Prof. Oleg Iliev - Department of Flow and Material Simulation at the Fraunhofer Institute for Industrial Mathematics \(ITWM\)- Kaiserslautern](#)
- [Prof. John Domingue - STI International](#)
- [Prof. Virginio Cantoni - Computer Vision & Multimedia Lab CVML, University of Pavia](#)
- [Prof. Ivan Kalaykov - Centre for Applied Autonomous Sensor Systems, School of Science and Technology, Örebro University](#)
- [Prof. Markos Papageorgiou - Dynamic Systems and Simulation Laboratory, Department of Production Engineering and Management, TU Crete](#)
- [Karina Angelieva - Joint Innovation Centre, Bulgarian Academy of Sciences](#)

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<http://iict.bas.bg/acomin/progress.html>


AComIn: Progress beyond the State of the Art

The project will involve the incoming post-docs in intensive RTD activities together with the IICT researchers and the highly skilled international partners. Using the advanced Smart Lab devices, AComIn will contribute to technology breakthroughs at least in the following areas:

- Area 1: **Advanced computing and Finite Elements applications**
- Area 2: **Monte Carlo methods, algorithms and distributed computing**
- Area 3: **Multimodal enrichment of voice communication**
- Area 4: **Large-scale approach to multilingual terminology**
- Area 5: **3D modelling and recognition in biometrics** applied to 3D face recognition based on large DB of face images, lips dynamics processing to help speech segmentation and recognition, iris dynamics and colors to enrich current eye tracking techniques and/or iris diagnostics, etc.
- Area 6: **Digital preservation of cultural heritage for research and education**
- Area 7: **High spatial resolution based on near-field focalisation**
- Area 8: **Hierarchical optimization in real time applications**
- Area 9: **Energy efficient production technologies**
- Area 10: **Maintenance of industrial facilities operating in aggressive environment**

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<http://iict.bas.bg/acomin/smartLab.html>

AComIn: the equipment to be purchased

The existing IICT Grid infrastructure includes 3 computer clusters in the European Grid Initiative infrastructure with a total of 916 CPU cores and about 110 TB SAN disk storage and 10 TB tape. The newest cluster, deployed in 2010, is a High Performance Cluster with 576 logical cores (2.8 GHz, Xeon 5560, 36 blades, 24 GB RAM), interconnected with non-blocking 20 Gbit/s DDR Infiniband fabrics, with 8 storage servers connected to 96 TB in two SAN disk arrays. One server with 4 GPU NVIDIA Tesla M2090 cards aids development of GPGPU-based algorithms and computer codes. Most of the funding for purchasing the HPC clusters was invested by national programmes. In addition to the HPC cluster at IICT, the IICT researchers also use the Bulgarian supercomputer IBM Blue Gene/P, located at the premises of the Ministry of Telecommunications, IT and Transport

The following devices for 3D output and input, speech processing and studying system dynamics are planned for purchase in AComIn:

- i. **3D Output / Visualisation Lab:**
 - a smart large-scale Visual wall
 - a 3D printer for producing physical 3D models
- ii. **3D Input Lab:**
 - a device for industrial X-ray and computed tomography (CT),
 - a 3D scanner for interactive and real time construction of 3D surface models from real solids
 - an Acoustic Holography environment for noise source identification,
 - an Infrared Camera
- iii. **System Dynamics Lab:**
- iv. **Speech Processing Lab:**
- v. **an Integrating Server Environment**
- vi. **Equipment Socialisation** to enable the effective integration and maintenance of Smart Lab devices within the computational infrastructure of IICT.

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AComIn: the equipment...

XT H 225
Industrial X-ray and Computed Tomography



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AComIn: the equipment...

ZPrinter Z650



- 10" X 15" X 8" - Build size
- .0035" - Z Layer thickness
- 540 X 600 - XY DPI resolution
- 74" X 29" X 57" - Machine size
- 24 Bit color (390,000 colors)



ZScanner Z700cx




- 18,000 Scan points per second
- .002" - Scan accuracy
- 2.85 lbs Weight
- .004" Scan point resolution
- 3 Cameras (2 - scan, 1 color)
- 250 DPI Color scanning resolution



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http://iict.bas.bg/acomin/opened_positions.html

AComIn: Opened positions


The IICT-BAS opens **one employment position for incoming post-docs** in the following areas:

- i. Advanced computing (supercomputing, high-performance computing, parallel processing etc.),
- ii. Language and semantic technologies,
- iii. Signal and image processing,
- iv. Optimisation and intelligent control.

In the AComIn context, **'incoming researcher' is a scientist who has been working outside Bulgaria for more than 2 years during the last 3 years.** The position will be opened for 12 months with option to extend till the AComIn project end. The salary is compliant to the FP7 Marie Curie rates. **Non-EU citizens will need working visa for employment in Bulgaria (and visa applications are made to the Bulgarian embassies in the candidate's country of residence).**

The set of application documents includes:

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the SP&PR department of IICT



Department

"Signal Processing and Pattern Recognition"

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Home Staff Projects Publications Seminars

PERMANENT STAFF

- ▶ **Assoc. Prof. Dimo Dimov** - Image & Speech Processing and Recognition, Content Based Image/Object Retrieval, Rapid & Reliable Access to Multimedia Databases, Data Mining & Information Retrieval Systems, Astroinformatics.
- ▶ **Assoc. Prof. Georgi Gluhchev** - Image Processing, Pattern Recognition, Biometrics.
- ▶ **Assoc. Prof. Vladimir Kyovtorov** - Signal and image processing, Statistical analysis, Communication and navigation techniques, Modelling and optimisation, Programming, Remote sensing, FPGA design.
- ▶ **Assist. Prof. Atanas Ouzounov** - Speech processing, Speaker recognition, Neural networks.
- ▶ **Assist. Prof. Valeri Ilchev** - Neural Networks, Pattern Recognition.
- ▶ **PhD Student Atanas Nikolov** - Image Processing, Pattern Recognition, Stereovision.
- ▶ **PhD Student Svetoslav Nedkov** - Image Processing, Pattern Recognition, Emotion Recognition.
- ▶ **Post-Doctoral Nadezhda Zlateva** - Image Processing & Pattern Recognition, Machine Learning.
- ▶ **Post-Doctoral Alexander Marinov** - Image Processing & Pattern Recognition, Machine Learning.
- ▶ **Post-Doctoral Desislava Boyadzhieva** - Pattern Recognition, Biometrics, Signature Based Identification.
- ▶ **Violeta Ivanova** - Programmer, Post-Doctoral, Research and creation of virtual educational environments.
- ▶ **Elizaveta Karaatanassova** - Research assistance.

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the SP&PR department of IICT...



MVI_2298.mov

MVI_4091.mov

...and here we rest
(before Xmas 2012 or 2011 ☺)






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the SP&PR department of IICT...



Current activities of the SP&PR department are concentrated on R&D in the areas of:


- ◆ Image, Video and Speech Analysis and Recognition;
- ◆ Content Based Image/Object Retrieval (CBIR/CBOR);
- ◆ Biometric based identification;
- ◆ Neural Networks for Classification, Computer assisted Medical Diagnostics, etc.

The Department has long-term interests in the technological development of information systems using Image Processing and Recognition.

The Department actively participates in European and National R&D projects and presents the results in international and national journals and conferences.


The Department is co-organizer of the annual international conference CompSysTech (2000-2011).

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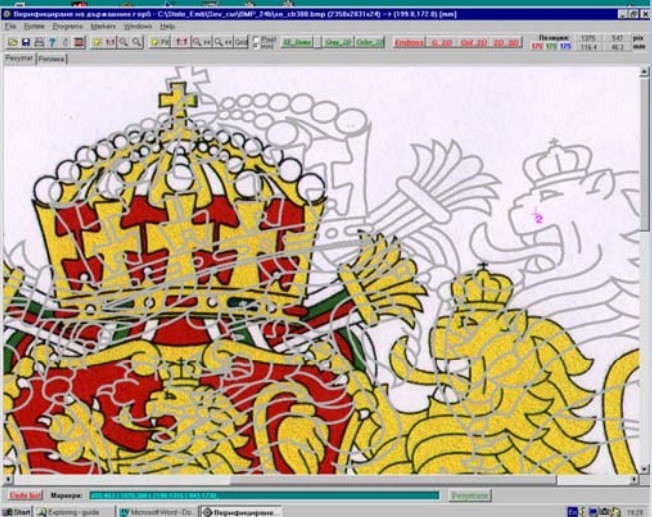


More Attractive Projects of SP&PR dep.




The STEMB system
for verification of replicas
of the Bulgarian State
Emblem
(Coat-of-Arms)
(2000 – 2001)


STEMB development
was sponsored by the
National Committee
of Standards and
Metrology
(STEMB is still in use)




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the STEMB system ...




Dani, an user from the (former) NCSM, demonstrates the STEMB system


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More Attractive Projects of SP&PR dep. ...




A system for identification of CDs producer & writer, a joint development of IICT-BAS and RICC-MoI, 2003.


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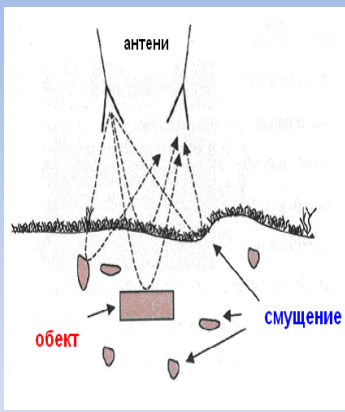


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More Attractive Projects of SP&PR dep. ...





- Geo-radar (2006-2007), ordered by Micro Systems Ltd., BG,
- team leader Prof. Ch. Kabachiev, team members Prof. K. Alexiev and Prof. V. Kyovtorov (V.K. is now an international expert of IICT in JRC, Ispra, Italy)

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IICT More Attractive Projects of SP&PR dep. ...

EFIRS – an Effective (& Fast) content based Image Retrieval System

input image → image content to a key → EFIRS → index key access → DBMS → Image DB of PORB

A result of EFIRS in operation

A few images from the DB of PORB (the Patent Office of Republic of Bulgaria)

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IICT EFIRS applied for 3D objects recognition

HS-histogram of a given frame.

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Data gathering for 3D objects of interest...




Here, we gather 3D data about faces.
(The year is 2007, and a 3D scanner costs >> \$30000 ☺)

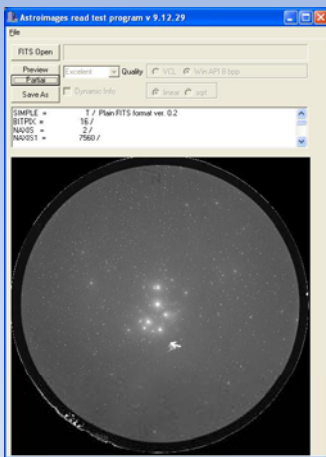
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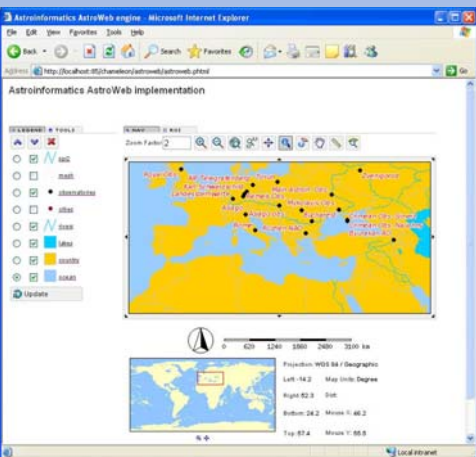
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The National Astroinformatics Project (2009-2012)






A system for meta data manipulation of FITS (Flexible Image Transfer System) files (most often used in astronomy).

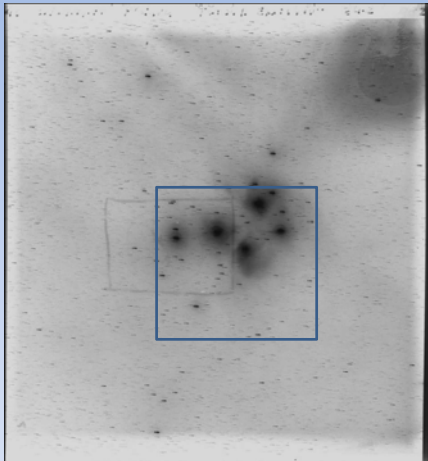
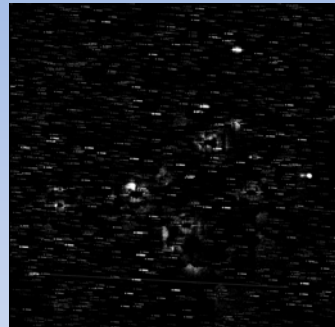
The AstroWeb system for geographical presentation of data sources for the WFPDB (a DB for the Wide Field Plates achieves) of the Inst. of Astronomy, BAS.

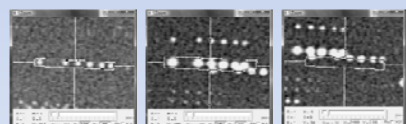
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A Hough Transform to Identification of Flare Stars in Multi Exposure Plate Images




An archival image of "chains" type covering 2*2 square degrees in the area of the Pleiades stellar cluster

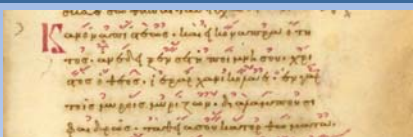
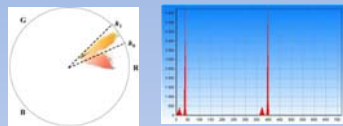
Examples of localized "star chains": a „normal" chain, and two overlapping chains.


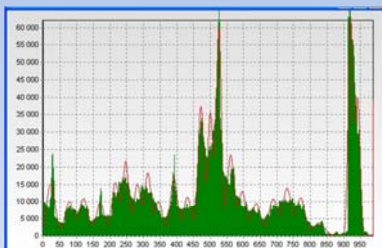
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Neume Notes Recognition




A fragment of an ancient manuscript, neume notes in red, and brown psalm texts (below them, in Greek)

The HS histo, and the respective circular H-histo


Isolated neumes (collisions solved)

A DB of neumes currently recognized (in green), and its optimal thresholding (23 Gaussian classes found)

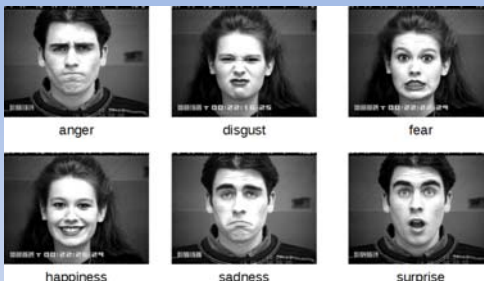
A neume and its FD approximation: by 1, 2, 8 and 16 Fourier harmonics.

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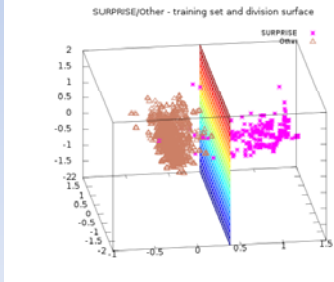
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Emotion Recognition by Face Dynamics




SURPRISE/Other - training set and division surface




We consider six basic emotions (and the neutral expression as well), and compare each face image (video frame) with the Candide-3 model to met FACS (Facial Action Coding System) and to calculate a subset of 11 Action Units (AU):


- AU2 (Outer brow raiser)
- AU4 (Brow lowerer)
- AU5 (Upper lip raiser)
- AU7 (Lid tightener)
- AU9 (Nose wrinkler)
- AU10 (Upper lip raiser)
- AU13 /15 (Lip corner depressors)
- AU20 (Lip stretcher)
- AU23/24 (Lip presser)
- AU26/27 (Jaw drop)
- AU42/43/44/45 (Eyes closed)



Our LDA classifier is trained to 7 classes by a DB of emotions currently gathered. E.g., see a 3D projection of the 11D plane that discriminates the "surprise" (in violet) vs. all other emotions (in brown).

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Other projects

Depth Estimation using Single Digital Still Camera


2D Real-Time Video Stabilization

(these are already presented by A. Nikolov a PhD student of IICT, a couple of weeks ago)


About other projects of the SP&PR dep. of IICT, see

http://iict.bas.bg/SPIR/en/projects-european_en.html

http://iict.bas.bg/SPIR/en/projects-national_en.html


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Supposed accents of next presentations

- **Rapid and Reliable Content Based Image Retrieval**
 - Fast Image Retrieval by the Tree of Contours' Content
 - A Polar-Fourier-Wavelet Transform for Effective CBIR
 - From 2D CBIR to 3D CBOR (Content Based Object Retrieval)
 - *Demo available:*
 - EFIRS – a Content Based Image Retrieval system*
 - EFIRS for Face Recognition*
- **Precise Approximation of (p,θ) -Hough Transform over a Rectangular Grid**
 - *Demo available: Exact (p,θ) -HT for Star Chain Images Processing*
- **Fourier Descriptors for Invariant Representation of 2D Contours**
- **Cyclic Histogram Thresholding and Multithresholding**
- ...


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the End

Thank you

(for your questions 😊)

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