



INSTITUTE OF INFORMATICS
SLOVAK ACADEMY OF SCIENCES



60

1956-2016



Scope of activities

scientific and research work in informatics, information technology, control theory, robotics and artificial intelligence

Departments:

Parallel and distributed information processing

Design and diagnostics of digital systems

Parallel computational methods and algorithms

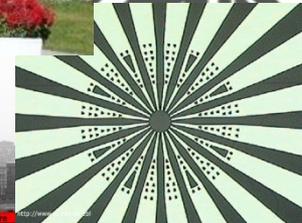
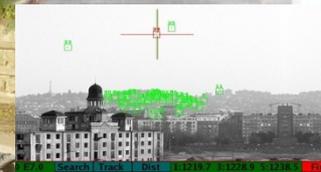
Discrete processes modeling and control

Sensor systems

Speech analysis and synthesis

Electron beam lithography

PCB design and production





Computing and Informatics

- International journal indexed in CCC
- 6 numbers each year
- Editorial board: 36 members from 15 countries
- 142 papers from 313 authors from 40 countries
- Reviewers: cca 60 from 25 countries
- IF 2015 (SJR) increased by 44%
(from 0,351 to 0,504)

**COMPUTING
AND
INFORMATICS**

formerly: **Computers and Artificial Intelligence**

[Editorial Board](#)

[Main Journal Topics](#)

[Instructions for Authors](#)

[Subscription Information](#)

[Contents](#)



Publications and citations

| | 2012 | 2013 | 2014 | 2015 |
|---------------------------------------|------|------|------|------|
| Monographs and chapters in monographs | 5 | 2 | 2 | 2 |
| Papers in CCC journals | 9 | 7 | 12 | 7 |
| Papers in WOS and SCOPUS | 33 | 39 | 55 | 40 |

| | 2012 | 2013 | 2014 | 2015 |
|---|------|------|------|------|
| Citations in WOS CC | 150 | 191 | 204 | 255 |
| Citations in SCOPUS | 89 | 73 | 87 | 101 |
| Citations in other citation indexes and databases | 146 | 147 | 173 | 148 |



Digital signal processing. Fast conversion algorithms



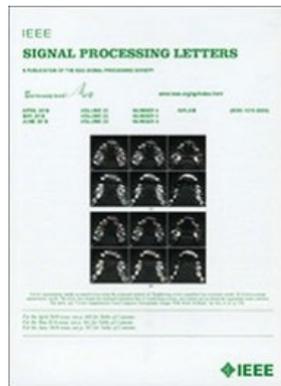
Selected research outputs

G. Davidson, chief of a research division of Dolby Labs and V. Britaňák

IISAS 2012-2015



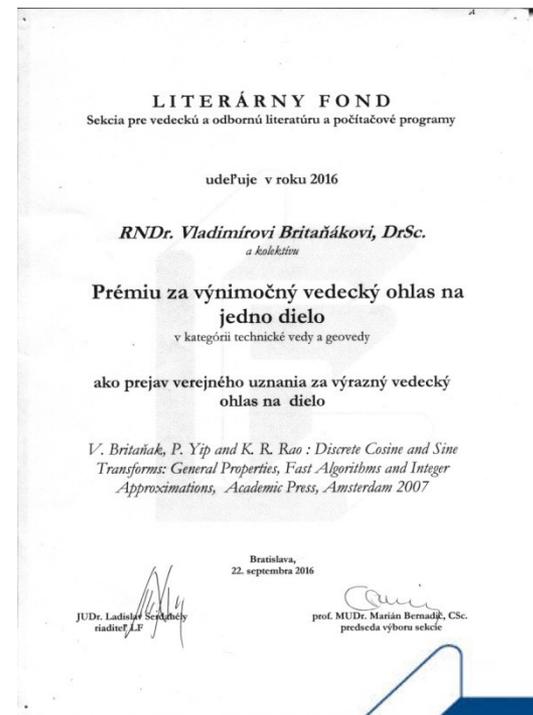
Digital signal processing. Fast conversion algorithms



Britanak, V. Fast conversion algorithm for the Dolby Digital (Plus)AC-3 audio coding standards, *IEEE Signal Processing Letters*, 2012, (1.388 - IF2011)

Britanak, V. New fast algorithms for the low delay MDCT computation in the MPEG-4 enhanced low delay audio coding standard, *Signal Processing*, 2014 (IF-2.209)

V. Britanak, Spectral Band Replication (SBR) compression technology: Survey of the unified efficient low-cost implementations of complex exponential- and cosine-modulated QMF banks *Signal Processing* 2015 (IF-2.209)



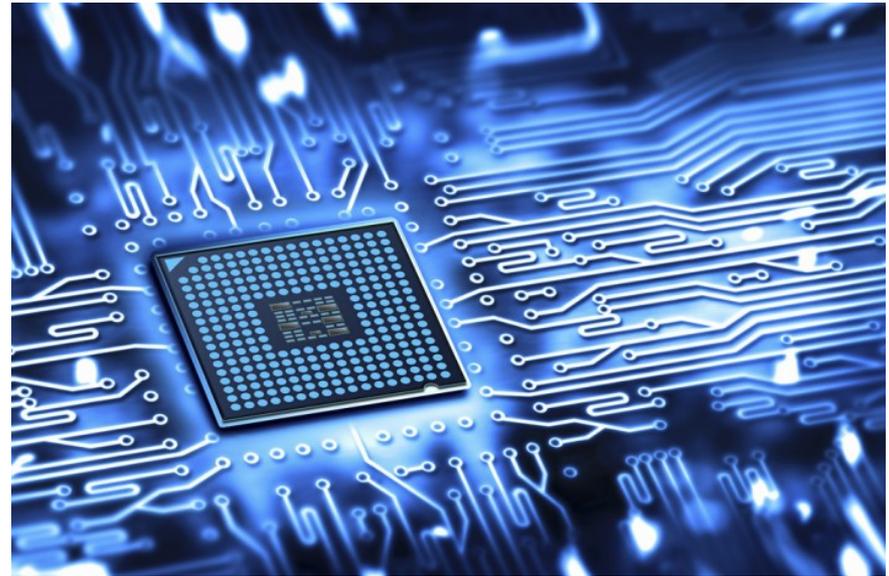


Reliability increase of digital cores in SoC. Test generation.

Self-repair architecture for digital circuits

- improves reliability
- prolongs durability.

2 new methods for the generation
of compressed skewed-load test
for transition delay faults (TDFs)
for wrapper-based logic cores of SOCs



DOBÁI, R. - BALÁŽ, M. SAT-based generation of compressed skewed-load tests for transition delay faults. In Microprocessors and Microsystems, 2013,

BALÁŽ, M. - KRIŠTOFÍK, Š. Generic Self Repair Architecture with Multiple Fault Handling Capability. In Euromicro Conference on Digital System Design : DSD 2015..



Entrainment, dominance and alliance in Supreme Court Hearings



Research on the entrainment – the tendency of conversational partners to speak in a similar way. Study was executed on the corpus of speech produced by justices and lawyers during oral arguments of the U.S. Supreme Court.

Project funded by US Air Force Office of Scientific Research

The goal – to test a hypothesis about correlation between **entrainment** and **trust** (reliance on another party's capabilities and knowledge when making decisions).

A specially developed computer game is used for data collection.

BEŇUŠ, Š. et al. Entrainment, dominance and alliance in supreme court hearings. In Knowledge-Based Systems, 2014, vol. 71, p. 3-14. (3.058 - IF2013). (2014 - Current Contents).

Selected research outputs





II SAS in EU programs

FP5 – 4 projects

FP6 – 8 projects



FP7 - 8 projects

- VENIS
- GAMMA
- Redirnet
- SeCriCom
- Commius
- ADMIRE
- EGEE-III
- EGI-InSPIRE



HORIZON 2020:

- EGI- Engage



European Defense Agency:

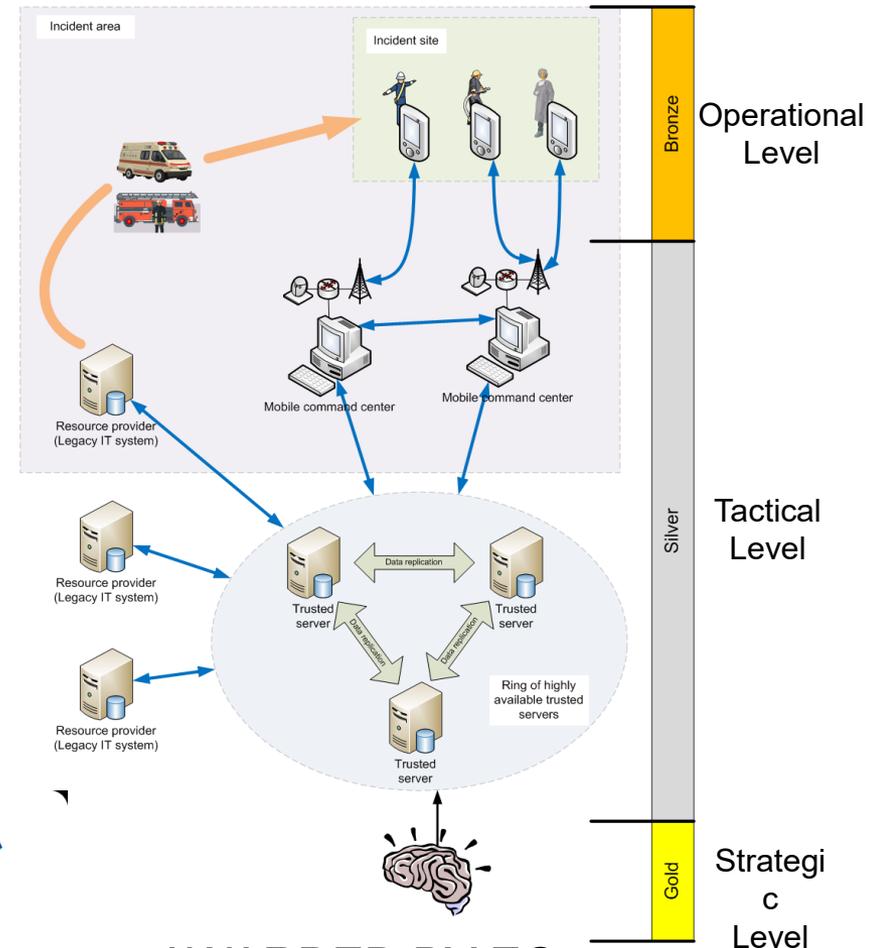
- EUSAS project





Seamless Communication for Crisis Management for EU safety

- Secure Docking Module with TU Graz (AU), on Push-to-Talk communication technology with Ardaco (SK), agent monitoring with Nextel (Spain) and reliable data routing with QinetiQ (UK)
- SAI - Secure Agent Infrastructure
 - Agents – collects information from information sources (at Trusted server) and communicates with end-users (first responders, IRS operators)
 - Management of information flow during crisis response



AWARDED BY EC

Dept. of Parallel and distributed computing

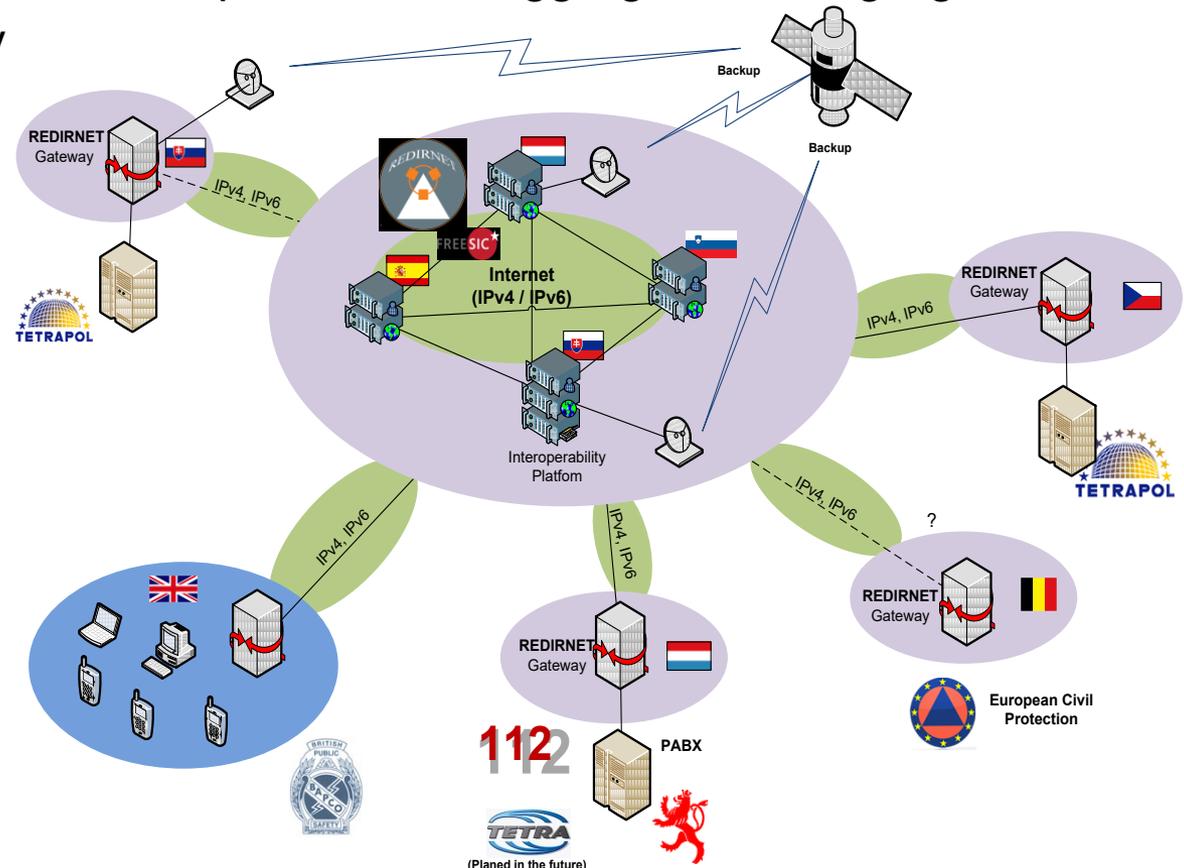


REDIRNET

Emergency Responder Data Interoperability Network



- REDIRNET – a new approach for communication of safety bodies – interoperability, connecting information resources, open interfaces, low cost, high level of flexibility
- Distributed system for large data acquisition and aggregation using agents and service oriented technology
- 9 partners for 7 countries





EUSAS Project: European Urban Simulation for Asymmetric Scenarios



Institut "Jožef Stefan"



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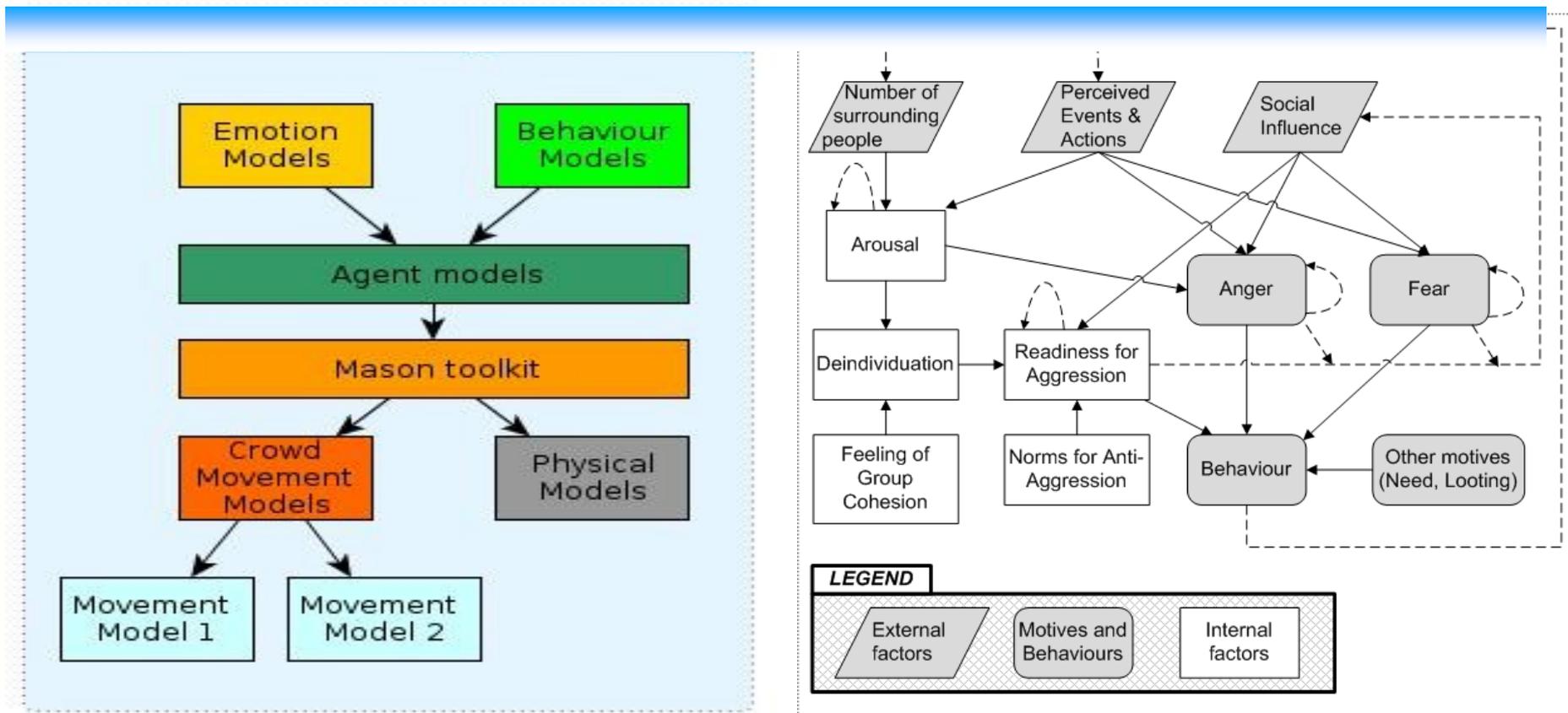
FOI





RIOT

Two Main Results:



1. Enriching agent architecture with **crowd movement models**
2. New method of **causal partitions** to analyze simulation data



Global ATM security management - GAMMA



Goal of the project:
To develop solutions
to emerging air traffic
management vulner-
abilities backed up
by practical proposals
for the implementation
of these solutions.

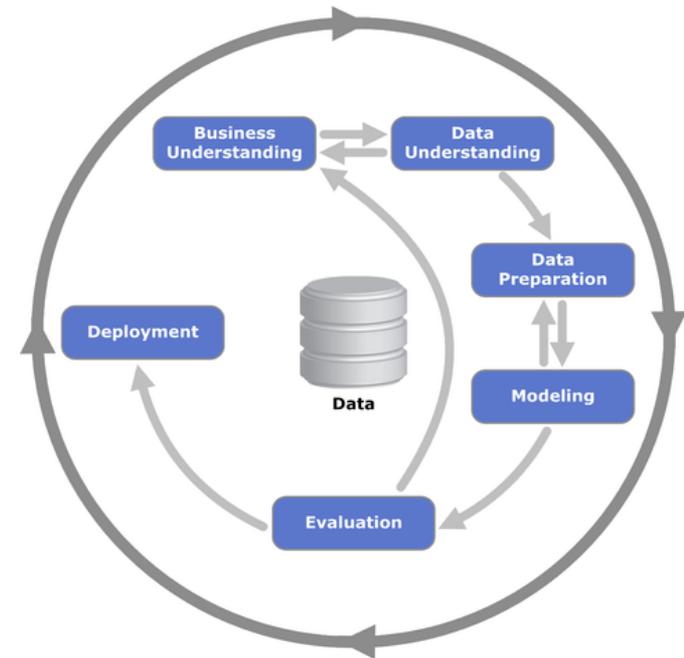
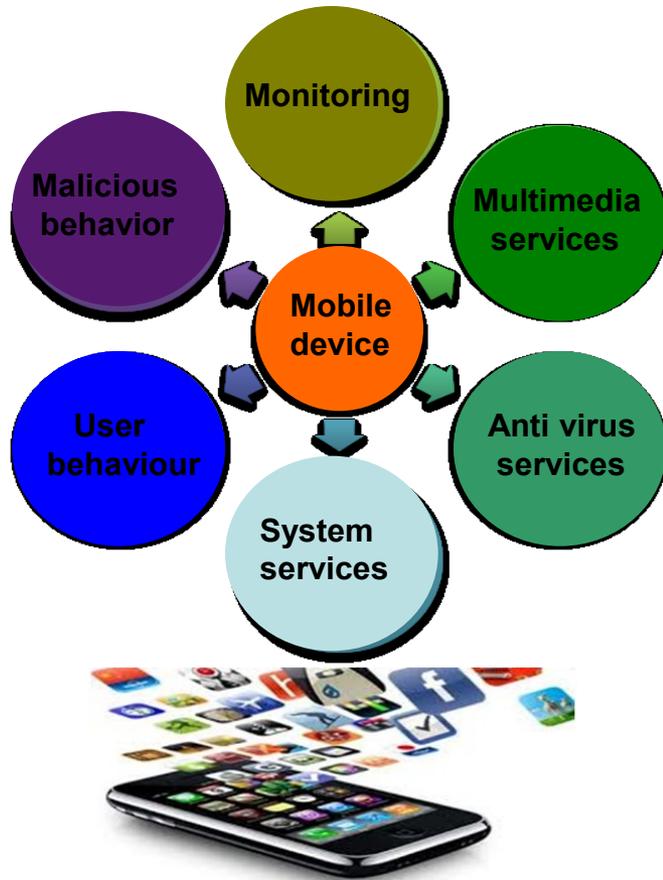


Worldwide consortium:
Boeing (USA),
AirBus (France),
Leonardo (Italy),
Thales (GB, Greece),
Institut für Flugführung
DLR (Germany),
CiaoTech (Italy),
II SAS, etc.





Detection of potentially dangerous activities from mobile device logs



Application of CRISP-DM (Cross-Industry Standard Process for Data Mining)

Application driven research

Dept. of Parallel and distributed computing





Knowledge oriented technology



Big Data processing
Information Retrieval
Natural Language Processing
Semantic Graphs and Networks
Reasoning and Inference
Semantic Search
Ontologies

- Knowledge Modeling
- Knowledge bases and Organizational Memories
- Artificial Intelligence
- Machine Learning
- Data Mining
- Mobile & Communication Technologies
- Multi-agent Systems



Natural language processing Achievements



4th place in Microsoft ERD Challenge 2014

Entity Recognition and Disambiguation in Search Queries

19 teams worldwide

Combined Full-text indexing, Information Extraction and Semantic Networks

Used Wikipedia, DBpedia and Freebase as Knowledge Base

No use of formal Semantic Model



2nd place in #MSM2013 Concept Extraction

Named Entity Recognition (NER) in Tweets

17 teams worldwide

Combined 8 different NER tools through Machine Learning techniques



1st place in Semantic Search Challenge 2011

Answering list type questions; e.g., Astronauts who walked on the Moon

Wikipedia as text and networks/graph

Text: IR methods, Lucene based

Graph/network: spreading activation and SemSets



Publications: 2012 IEEE 28th Int. Conf. on Data Engineering

KDD '13, WWW '12



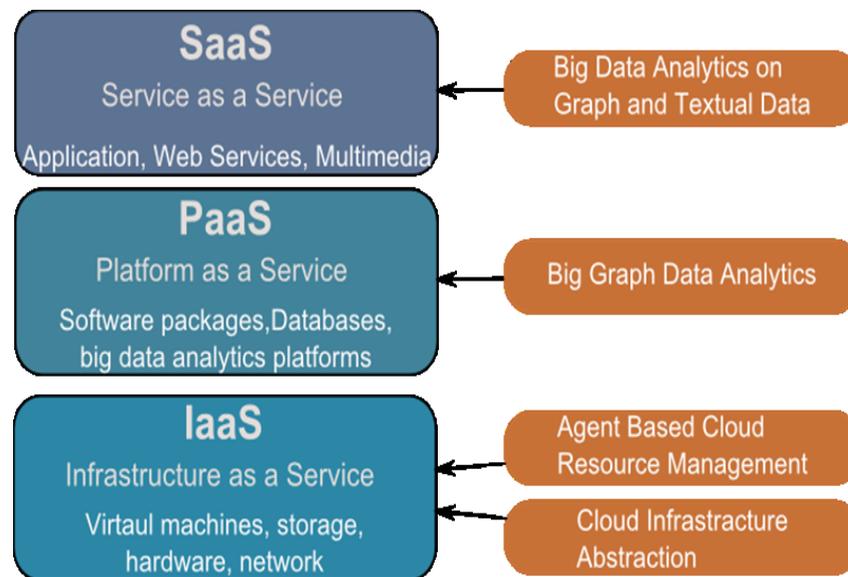


CLAN –

Cloud Computing for Big Data Analytics

Objectives:

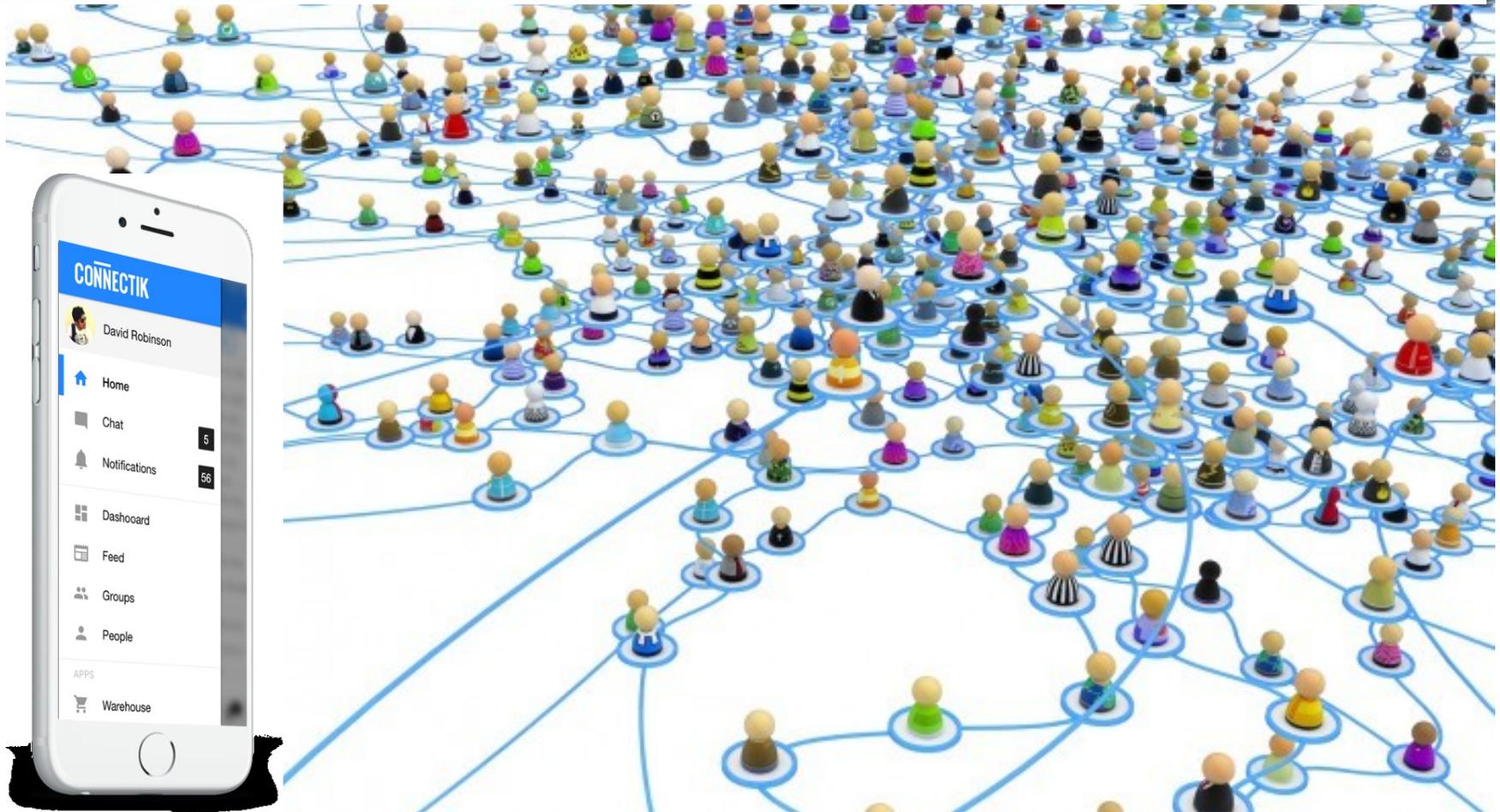
- Exploit mobile, autonomous agent systems to address the complexities of Cloud resource management.
- Provide abstraction layer for dealing with interoperability of the Cloud middleware.
- Design a distributed graph data management system, suitable for the Cloud infrastructure, able to handle large graph data.
- Combining large scale graph analysis with large scale text processing to address challenges of processing text data entwined with graph data.



AGENTÚRA
NA PODPORU
VÝSKUMU A VÝVOJA



CONNECTIK



Application driven research

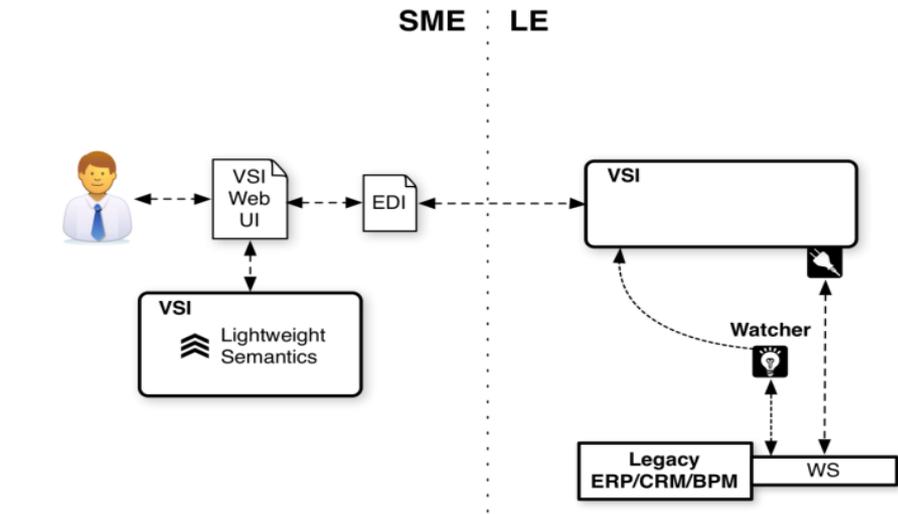
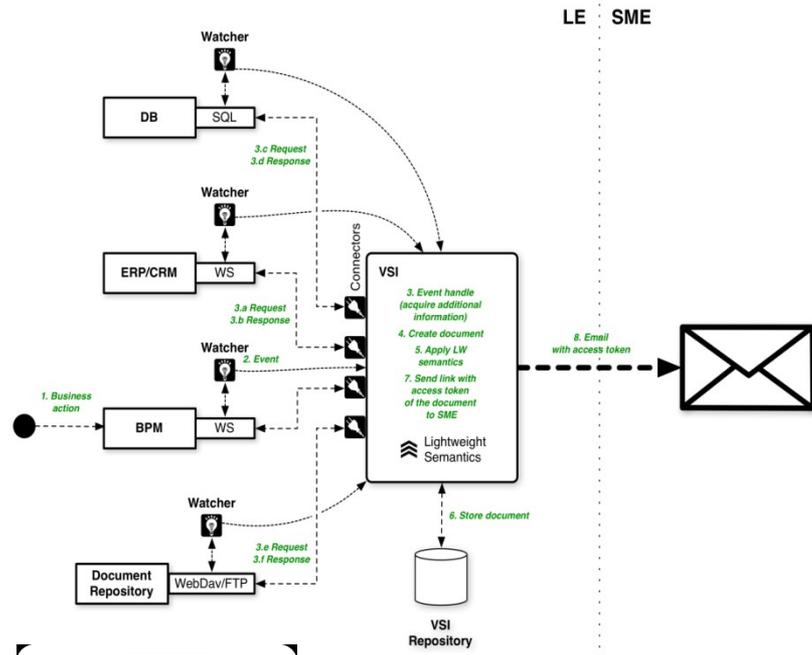
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VENIS

Services for enterprises interoperability

Large Enterprise to Small Enterprise Interoperability



Small Enterprise to Large Enterprise Interoperability





Discovery: Retrieving information from the Internet, knowledge extraction and recommendation

Pilot application BBC

BBC news monitoring and relations discovering



Examples: Simple Spatial

Find:

Field Facets

- Person
- [Boris Becker](#)
 - [Sunny Intervals](#)
 - [Dominique Strauss-Kahn](#)

[More Like This](#)

ID: <http://feeds.bbci.co.uk/news/business-11426889/rss.xml>

Title: BBC News - Technology of Business

Persons

Pilot application Egene

Application focused on matching a job offers (<http://www.linkedin.com/jobs>) with CVs



Examples: Simple Spatial

Find:

> [DocType:"Job"](#)

70116 results found in 106 ms Page 1 of 7012

| | |
|--|---|
| DocType | More Like This |
| Job | ID: http://www.linkedin.com/jobs?viewJob=&jobId=1013615 |
| JobTitle | Title: Senior Project Manager at PHT Corporation in Greater Boston Area - Job LinkedIn |
| Shift_Supervisor (US) | Job Title |
| Rep_Retail_Sales | Senior Project Manager |
| Barista (US) | Job Company |
| Account_Executive | PHT Corporation |
| Teller | Job Location |
| Account_Manager | PHT Corporation - Greater Boston Area |
| Project_Manager | Job Posted Date |
| Personal_Banker (Safe)_1 | Sun Dec 04 01:00:00 CET 2011 |
| Business_Development_Manager | Job type |
| Software_Engineer | Full-time |
| JobCompany | Job skill |
| Microsoft | certification Information Technology project management Project Management PMP Consulting |
| Hewlett-Packard | |
| CyberCoders | |
| Wells Fargo | |
| SAIC | |
| Qualcomm | |

Application driven research

Dept. of Parallel and distributed computing



Automated transcription of dictate

- ~ 3000 active licenses of the specialized dictation system
 - for **judges** (contract with Ministry of Justice)
 - and **prosecutors** (project: Electronization of services at the Office of the Prosecutor General)



Training of using the transcription and dictation software at Nitra County Prosecutor's Office



Automated transcription of dictate

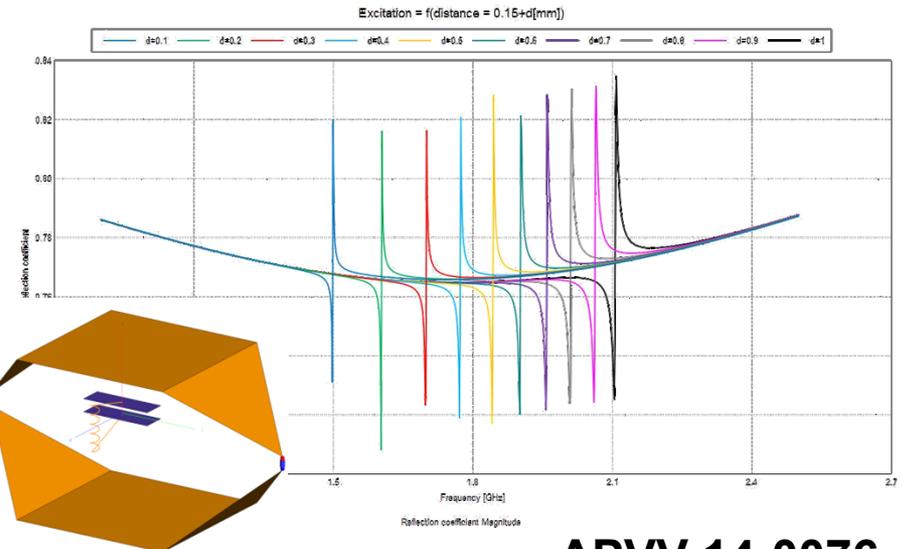
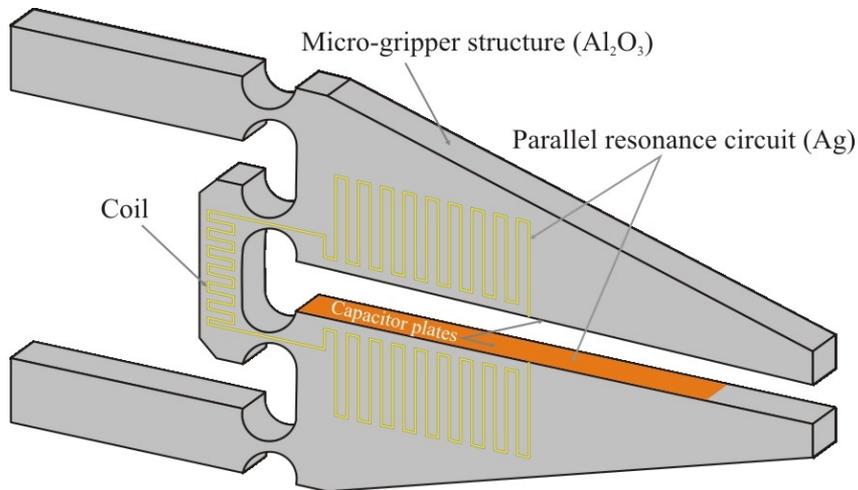
- **The award** of the Minister of Education, Science, Research and Sport in the category of Scientific and Technical Research Team of the Year 2012. (Department of speech analysis and synthesis)





Micro-Electro-Mechanical structures based on load cell

- **Main objective:** The analysis, synthesis and design of electromechanical sensors based on **MEMS** with **wireless transmission** of information about the sensed phenomena
- **General idea:** it is an assumption, that whole compliant robotic structure will be work under influence of electromagnetic field. In the case of structure deformation, some parameters of this electromagnetic field will change (in linear dependence)



APVV-14-0076

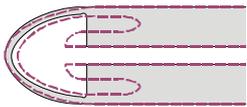


MEMS structures based on load cell

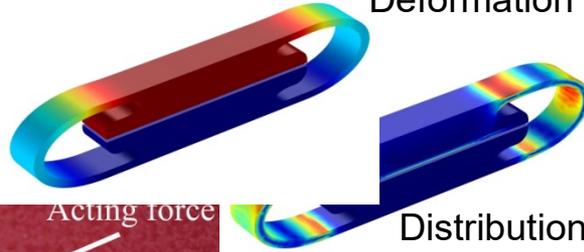
- Results:** flexural bodies for force/displacement sensor (one and two axis structures)

One axis structure

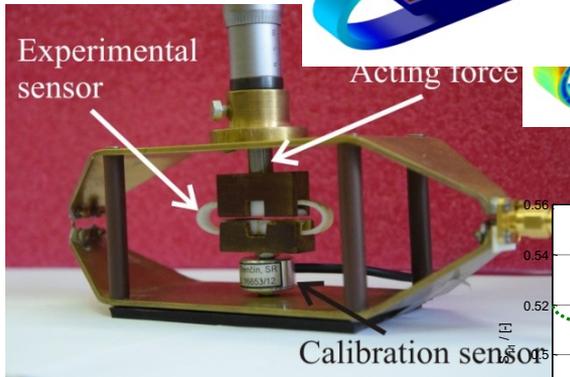
Structure optimization



Deformation



Distribution of stress

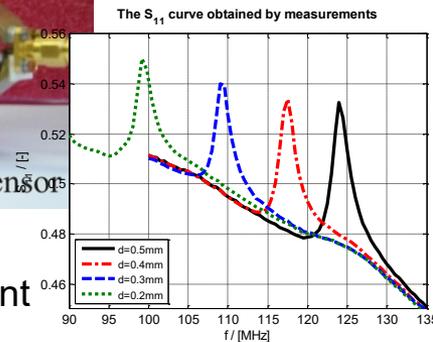


Experimental sensor

Acting force

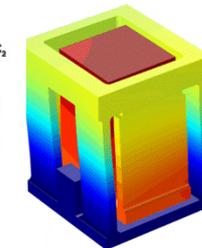
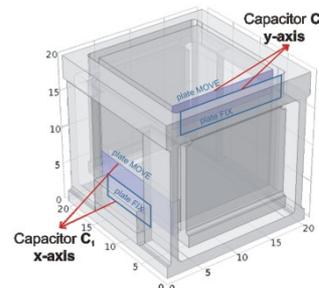
Calibration sensor

The arrangement of experimental measurement



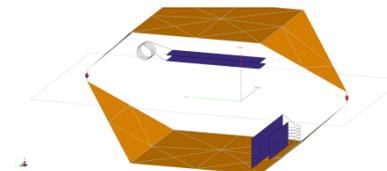
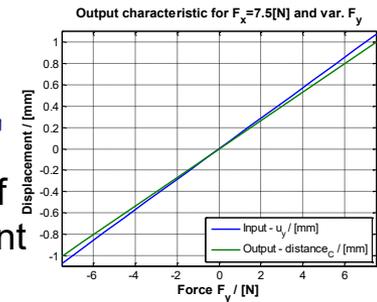
The results from the measurement

Two axes structure

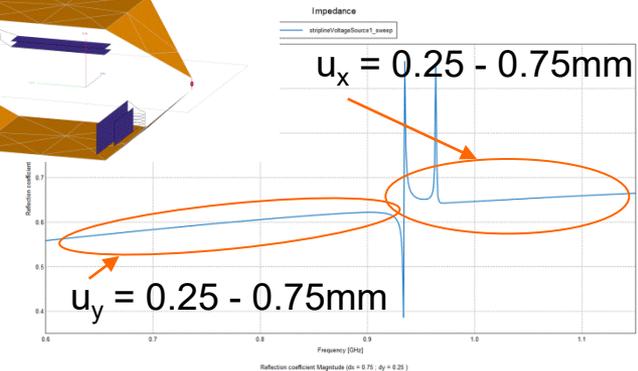


Animation of the movement

Two independent parallelograms



EM field simulation



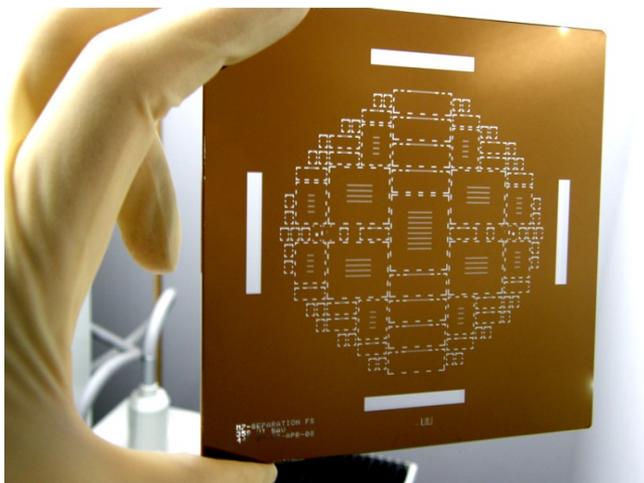


Electron beam lithography

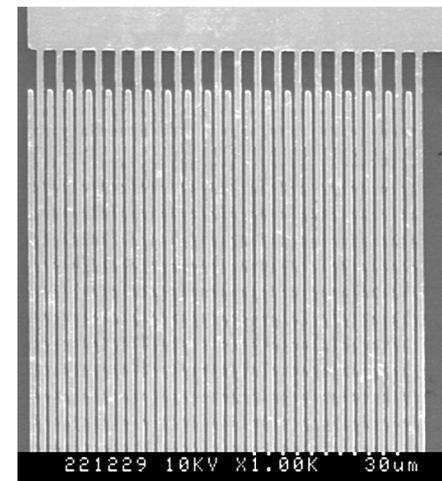
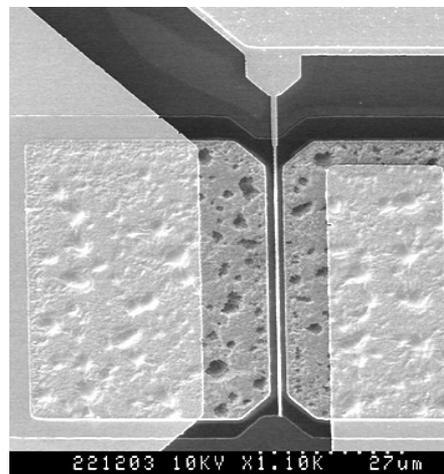
APVV projects: Advanced piezoelectric MEMS pressure sensors **APVV-0450-10**
Broadband MEMS detector of terahertz radiation **APVV-14-0613**

Coordinator IEE SAS

Our contribution: technology of polyimide membrane preparation and electron beam lithography for the fabrication of micro-electro-mechanical structures



**Photomasks for
sensor development**



**Direct writing e-beam lithography
on semiconductor AlGaIn/GaN thin films**

Electron beam lithography – international cooperation



- **IMS Nanofabrication AG** (Austria) - a leading edge company - a strong innovator in the area of lithography and structuring of materials in nanometer dimensions.
- **AMG Technology Ltd.** (Bulgaria) - an independent small enterprise in semiconductor manufacturing technologies on silicon and design & technology development of integrated MEMS.





Mechatronic Vision System

Fire Control Testing



The system has been embedded into the Ballistic Anti Aircraft Fire Control System developed in cooperation with the Slovak company EVPU a.s. Nová Dubnica within an upgrade of the Indian Army's ZU-23 anti-aircraft gun



RAAD 2014 - 23rd International Conference on Robotics in Alpe-Adria-Danube Region



- Conference sponsorships by IEEE and IFToMM
- No. of submitted papers: **62**
- No. of accepted papers: **57**
- No. of participants **>75** from **16** countries
- Proceeding registered in IEEEExplore and Scopus





Virtual digital design laboratory

Project *Virtual digital design laboratory for high school students (VILAB)*

partners: *6 secondary schools of electrical engineering and applied informatics in Bratislava, Levice, and Komárno*

- *courses* of digital circuit designs **103 students, 284 hours**
- professional design software used in *teaching* and *training* classes **296 students, 6 subjects**
- expert student praxis at the Institute **4 students**
- *selected topic special lessons* by researchers at schools **7 hours, 14 classes**
- competition *My first digital design* **16 students**



The background is a complex digital landscape. It features a blue grid that recedes into the distance, creating a sense of depth. Interspersed within this grid are various glowing green elements, including lines and points of light. Scattered throughout the scene are several numbers, such as '6', '4', '5', '2', and '3', which appear to be floating or part of the data stream. The overall color palette is dominated by deep blues and vibrant greens, giving it a high-tech, data-driven aesthetic.

BigData



Accelerated Computing in Cloud

EGI-Engage project



HORIZON 2020

- IISAS-GPUCloud – production cloud site with graphical accelerators (GPGPU)
- Cooperating on cloud middleware for GPGPU and their integration into „EGI FedCloud“ infrastructure
- Execution of large testing to optimize efficiency and to address stability of virtuals in clouds
- Providing Horizon portal with a new module to work with OpenStack, rOCCI, etc. for EGI users
- Design, development and implementation of several scripts to automatize some work within cloud
- Support of virtual organizations and applications from EGI database „AppDB“

IISAS-GPUCloud
Hardware:

IBM dx360 M4 server with two
NVIDIA Tesla K20 accelerators
16 CPU cores, 64GB RAM, 1 TB
storage on each WN

2x Tesla K20 on each WN, each with
2496 CUDA cores, 5GB GDDR5
RAM, peak performance 3.52
Tflops for SP

Software

Based OS: Ubuntu 14.04 LTS

KVM hypervisor with passthrough

Openstack Liberty middleware

Newest FedCloud tools



EGI Service Catalogue for the next Egi.eu flagship project

Compute



Cloud Compute - Run virtual machines on-demand with complete control over the computing resources



Cloud Container Compute - Run Docker containers in a lightweight virtualised environment



High-Throughput Compute - Execute thousands of computational tasks to analyse large datasets

Storage and Data



Online Storage - Store, share and access your files and their metadata on a global scale



Archive Storage - Back-up your data for the long term and future use in a secure environment



Data Transfer - Transfer large sets of data from one place to another

Training



FitSM training - Learn how to manage IT services with a pragmatic and lightweight standard

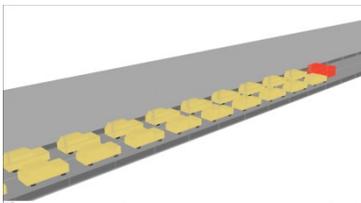


Training infrastructure - Dedicated computing and storage for training and education

<https://www.egi.eu/services/>



Computer modelling and simulation of fires



TOS - Traffic
& Operation
Simulator

accident with fire smoke test computer simulation

Testing applicability of advanced fire simulators in SR: competent use for practical safety issues in SR, excellent practice dissemination in SR

New knowledge on parallelization of fire simulation: efficient and reliable realization of fire simulation on HPC cluster (efficiency, accuracy, reliability)

Collaboration

Presidium of Fire Fighting and Rescuing Corps, MI SR

Fire Fighting Technical and Expertise Institute, MI SR

National Railway Company - simulation of critical fire scenarios in two road tunnels validated by smoke tests

PPA Engineering leading supplier of safety systems for road tunnels in SR
visualization of smoke stratification in TOS (contract)

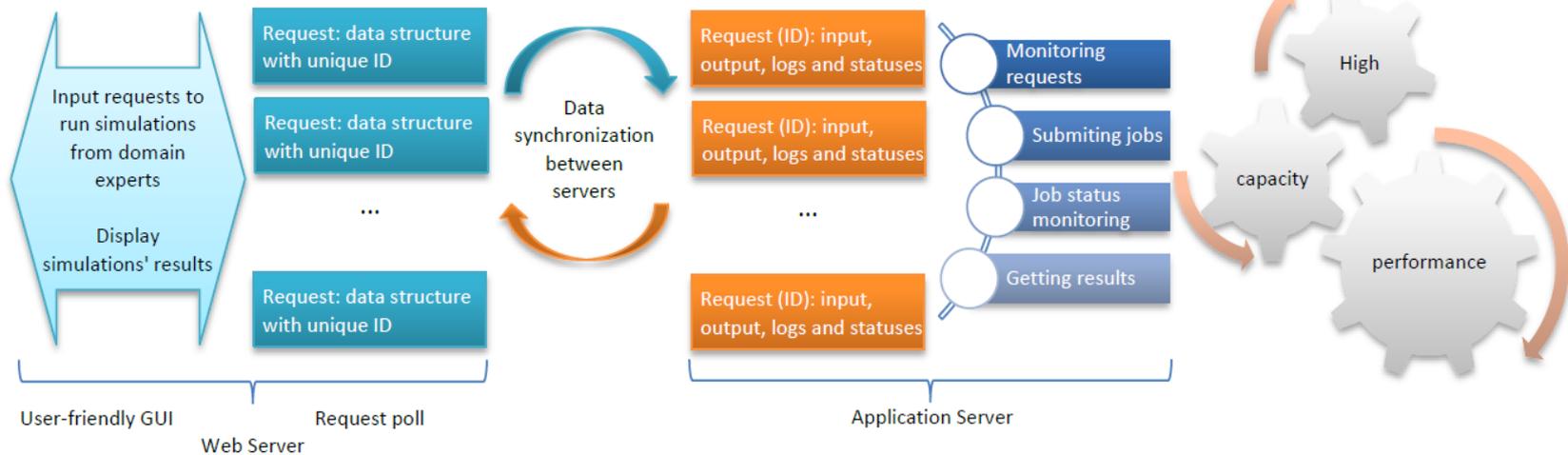
Faculty of Safety Eng., VŠB-TU Ostrava (Czech Rep.), K.B.K. fire (Czech Rep.)



Unified nanoscale gateway to HPC and Grid environments



- Activity in EGI-Engage EU H2020 and SIVVP ESF



Department of Electron Beam Lithography
Institute of Informatics Slovak Academy of Sciences

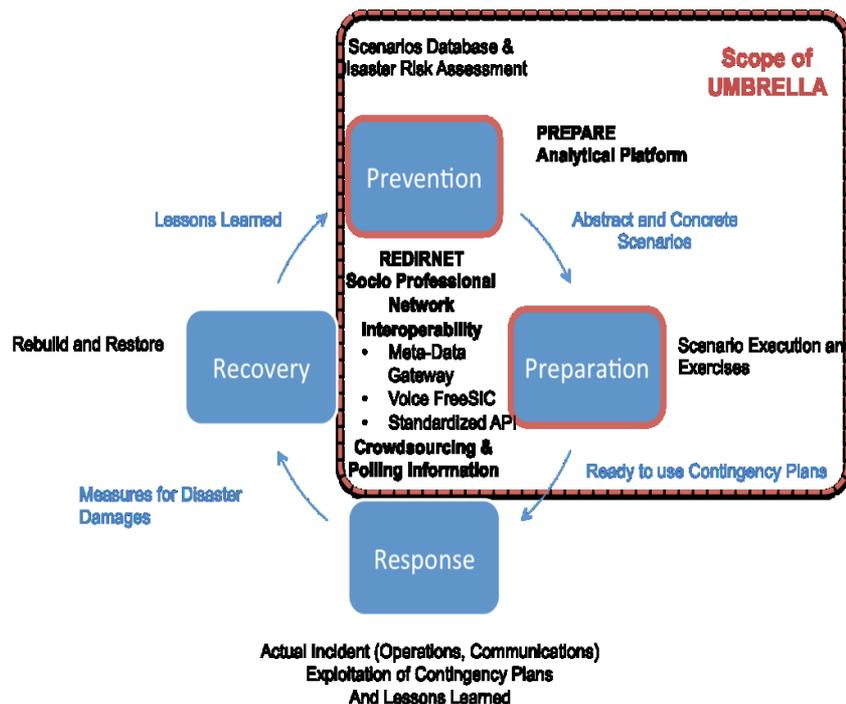
Dept. of Parallel and distributed computing
Dept. of Electron Beam Litography



UMBRELLA

Integrated Tools for Cross-border Incident Preparedness, Response Planning and Scenario Building

- Project follows the successful projects SECRICOM & REDIRNET
- UMBRELLA aims at providing a solution for streamlined coordination and communication by interlinking a variety of first responders from different countries and existing national and international supporting services and agencies by exploiting an interoperability solution embracing advanced tools and systems for emergency response.





COBE



Cost-effective Border Security extension tool for Europe

Submitted to Call: H2020-SEC-2016-2017

Topic: SEC-14-BES-2016 – Towards reducing the cost of technologies in land border security applications

Coordinator: ARDACO a.s., Slovakia

Consortium: 10 research and commercial institutions, 3 end-user partners from 7 EU countries





Simpatico

Personal Security Assistant platform for Public Administrations



ÚSTAV INFORMATIKY

Thank you!

5810





Technologies & Infrastructure

- **Web Crawling**
 - Apache Nutch + Plugins
- **Full-text search**
 - Lucene, Solr
- **Natural Language Processing**
 - Stanford Core NLP, Cognitive Computation Grout NLP Tools, GATE, Ontea
- **Large-scale Data Processing**
 - Hadoop, Spark, Pig, Hive
- **Graph processing and Querying**
 - Simple Graph Database (SGDB), gSemSearch, Neo4j, Blueprints
- **Machine Learning**
 - Vowpal Wabbit, Weka



- IBM cluster with 54x12=648 computing cores and 96 TB disk storage (all cores connected with InfiniBand)
 - + 6 managing servers
- HP blade cluster with 14x8=128 computing cores and 48 TB disk storage (including 6x8 cores connected with InfiniBand)
- HP blade nodes used as experimental cloud computing system with 32 cores
- PC cluster with 16x4 computing cores
- PC cluster with 16x2 computing cores
- Hadoop cluster with 6 computing nodes
- many other necessary servers



EGI-InSPIRE project

Integrated **S**ustainable **P**an-European **I**nfrastructure for
Researchers in **E**urope

A 4+ year project with €25M EC
Contribution (2010-2014)

- Project cost €72M
- Total Effort ~€330M
- Effort: 9261PMs

Project Partners (50)

EGI.eu, 38 NGIs, 2 EIROs
Asia Pacific (9 partners)





EGI-InSPIRE

A sustainable production infrastructure

- Resource providers in Europe and worldwide
- With new technologies as they mature

Support structured international research

- Sustain current domain specific services
- Attract new user communities (e.g. ESFRI)

SlovakGrid



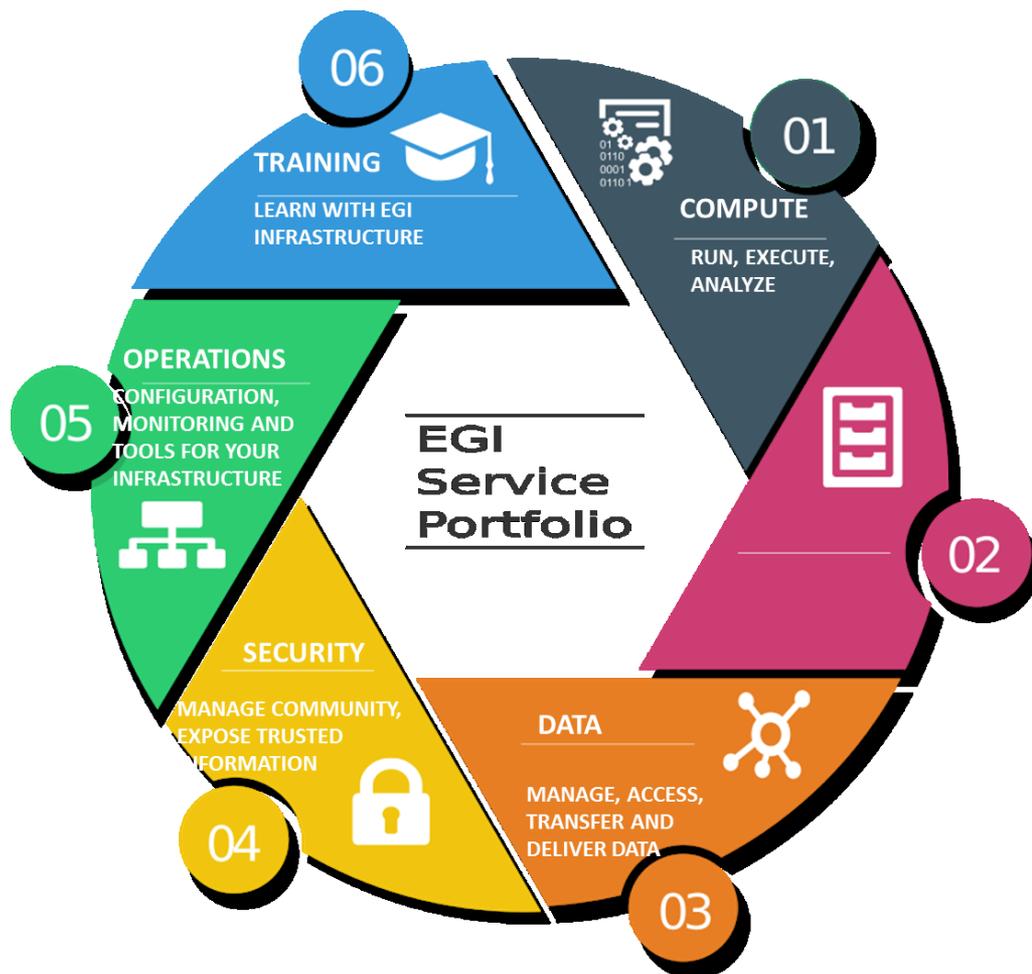
- National Grid Initiative in Slovakia (NGI_SK in EGI)
- support for complex scientific computing
- effective knowledge sharing
- providing dynamic virtual organizations
- promote international collaboration – European Research Area



Ján Astaloš, Ladislav Hluchý, Miroslav Dobrucký, Viet Tran at EGI project meeting in Madrid, 2013



EGI-Engage project



Project overviews:

- Duration: 03.2015-09.2017
- Partners: over 70 institutions from over 30 countries
- Coordinator: EGI Foundation

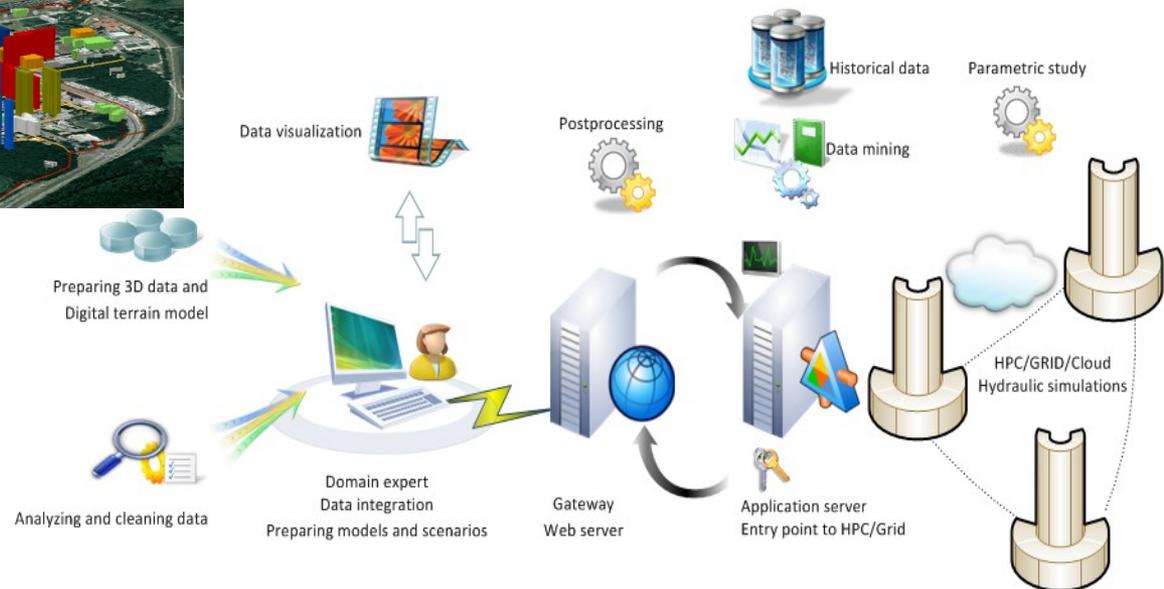
- Objectives: to accelerate the implementation of the Open Science Commons by expanding the capabilities of a European backbone of federated services for compute, storage, data, communication, knowledge and expertise, complementing community-specific capabilities.



Tools for hydraulic simulations in high-performance environments

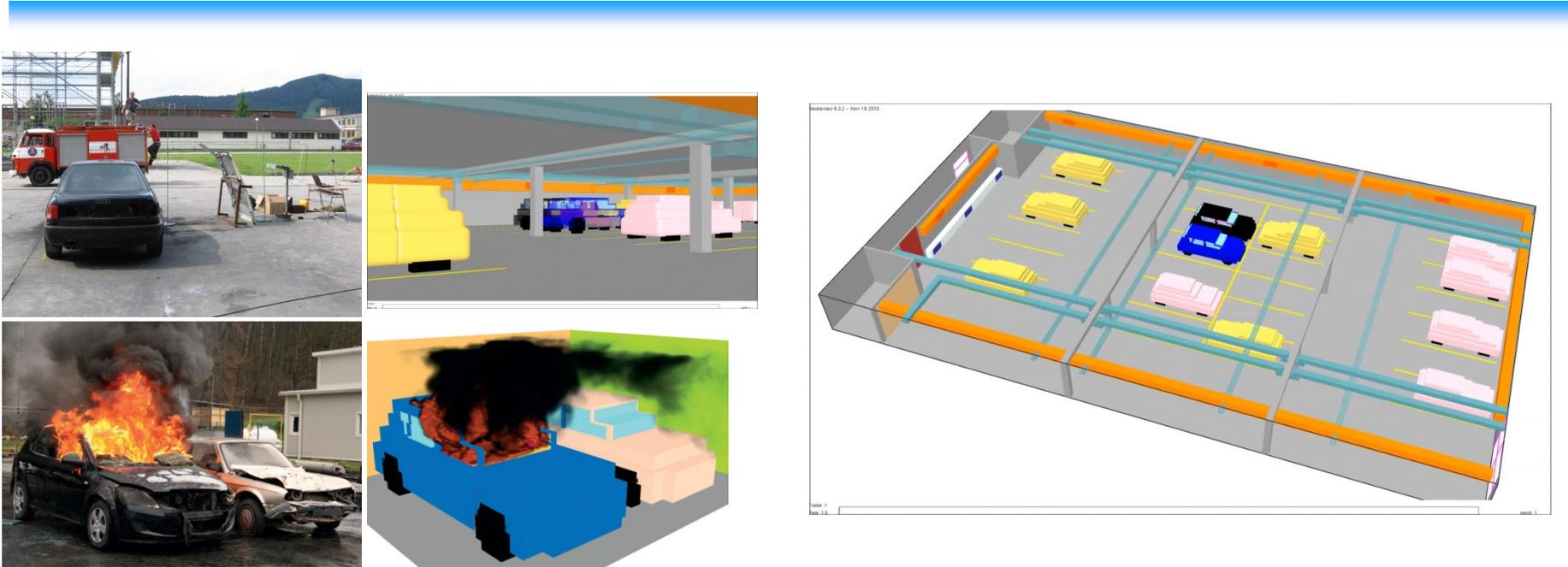


Output visualization of hydraulic simulations (pressure, velocity, etc.) Bratislava's water-supply system





Computational demanding applications - Fire Simulation I



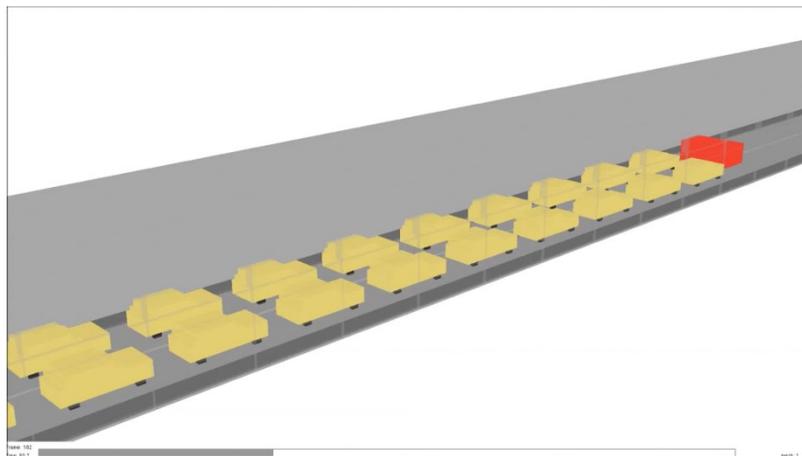
Fire simulations solved on HPC cluster:

- ❑ **automobile fire in open air and its spread on adjacent vehicle** validated by experimental data from full-scale fire tests
- ❑ **automobile fire in car park** (the car fire validated by full-scale fire tests)





Computational demanding applications - Fire Simulation II



Fire simulations on HPC cluster:

❑ **road tunnel fire** (smoke movement in tunnel tube, safety systems reaction, smoke stratification)

Research on performance and reliability of fire simulations on HPC cluster:

❑ **parametrical studies on the impact of parallelization**
on simulation efficiency & accuracy



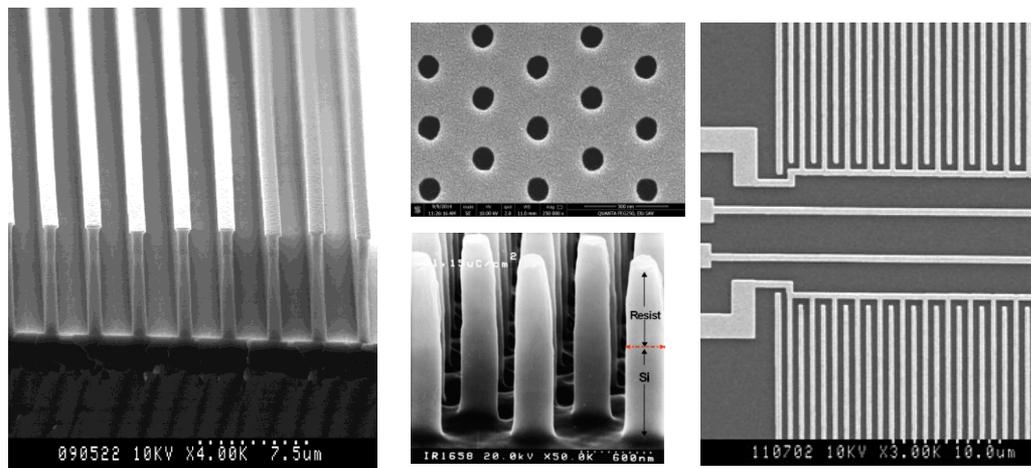


Electron beam lithography

CENTE I a II - Projects of the European Regional Development Fund ERDF (Structural found) ITMS – 26240120011 and 26240120019
Centre of Excellence for New Technologies in Electrical Engineering, 2009- 2013,

Partners - 5 institutions of the Slovak Academy of Sciences

Our contribution: The exploitation of new research infrastructure for R&D projects - Laboratory of Electron beam lithography (Activity 2.4).



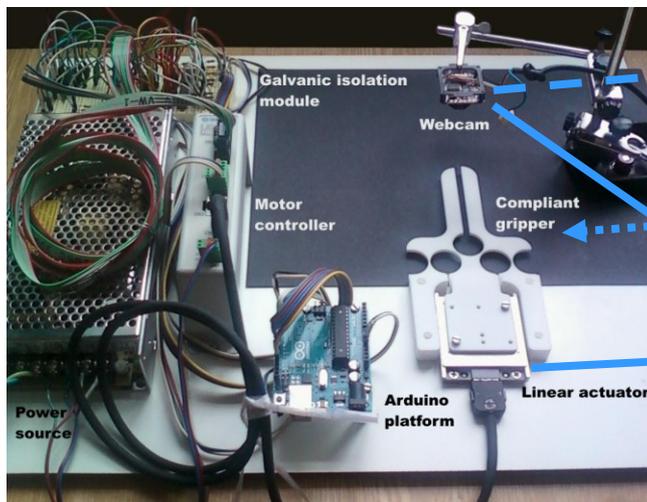
Gallery of electron-beam lithography structures



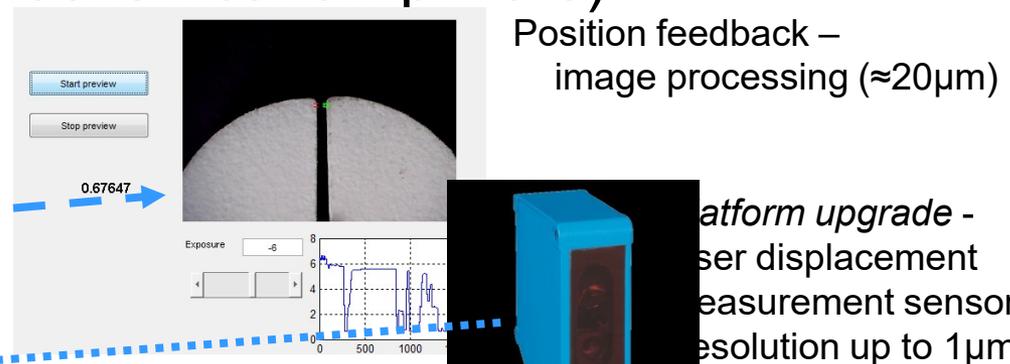
Experimental platform for tests of compliant structures



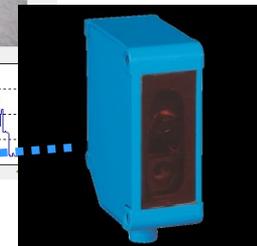
- for verification of performance characteristics of various compliant devices used in robotics (e.g. mechanisms, grippers, sensors and mechanical amplifiers)



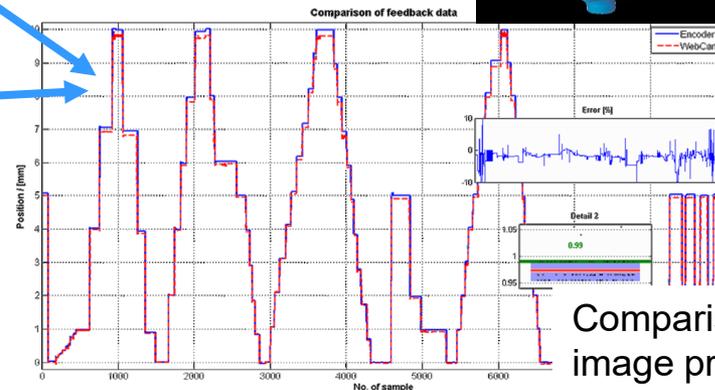
Experimental platform for tests of compliant structures



Position feedback – image processing ($\approx 20\mu\text{m}$)



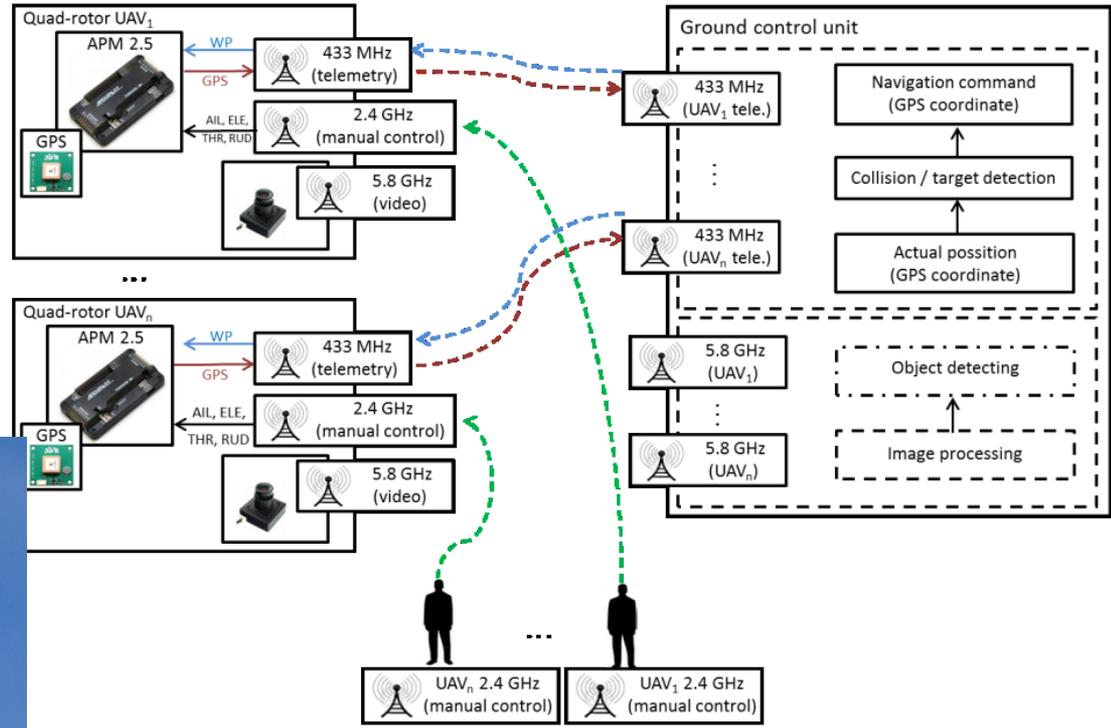
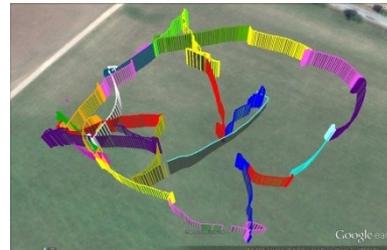
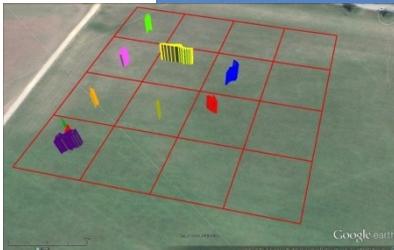
Platform upgrade – laser displacement measurement sensors (resolution up to $1\mu\text{m}$)



Comparison of feedback data image processing vs. encoder



Swarm robotics and IoT laboratory



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Questions?

www.ui.sav.sk/w/en/labs