Research Laboratory for Proactive Technologies

Department of Computer Control

TUT

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Research Laboratory for Proactive Technologies
Department of Computer Control
Tallinn University of Technology

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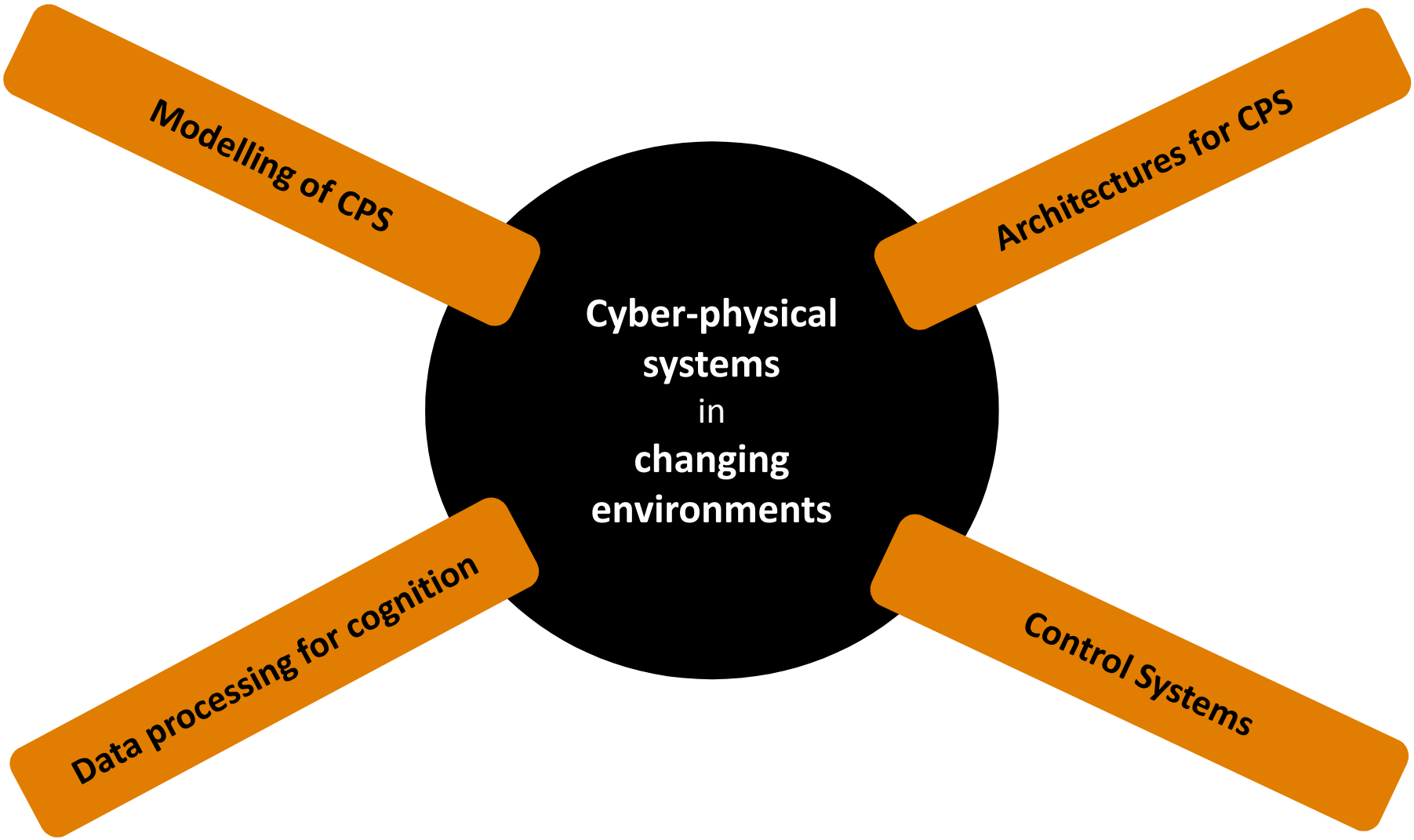
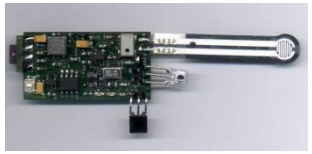


Pervasive computing

Cyber Physical Systems

- Also *ubiquitous*, *invisible computing*
- Devices and systems work in the environment
  - Invisible to the human
  - Without the aid of a human

Technologies



- Sensing and sensors
  - Various modalities (temperature to visual)
  - Signal processing to detect situations of interest

- Communication in distributed sensing and control applications
- Machine cognition and situational awareness in SoS
- RFID, sensor networks – tagging and monitoring objects

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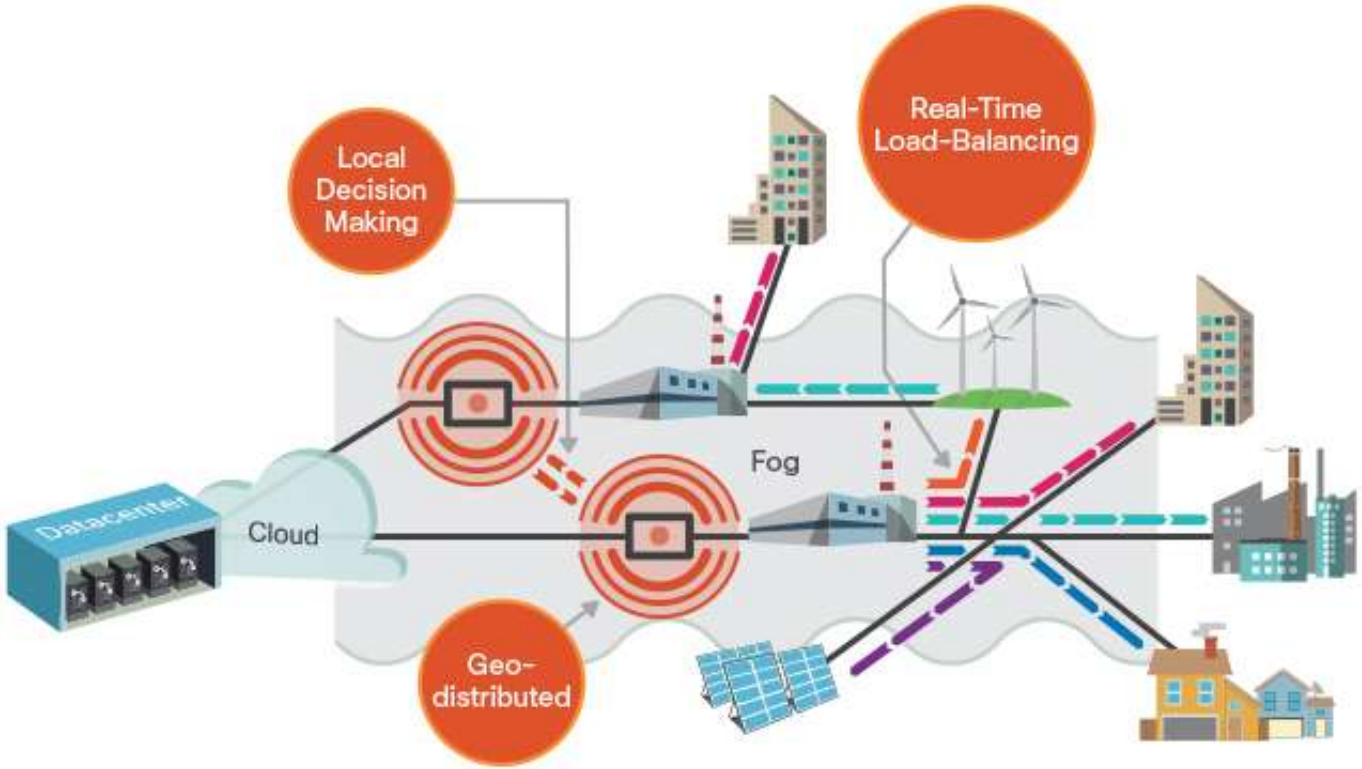
Smart networks

- Sensing and computation occurs in the network
  - Signal processing
  - Local decision making
- ProWare – proactive middleware enables collaboration of embedded devices
- Simple devices can become smart and work together
  - Street light can talk to a movement sensor

Mist / Fog computing

Internet of Things



Moving ing computing from the Cloud to the edge of the network

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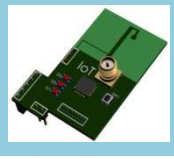
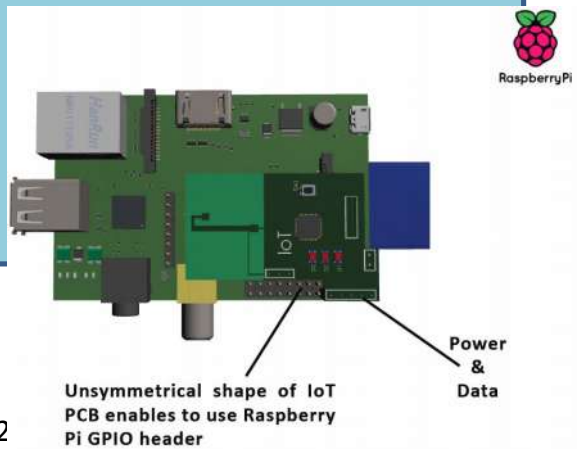
Internet of Things applications

- with Thinnect (Estonian SME)
  - Mist computing applications, e.g., building information management
- with Cityntel (Estonian SME)
  - Smart street light control product, operational in 5 countries
- IoT module
  - Contains ProWare & IoT mesh
  - Raspberry PI
  - Arduino





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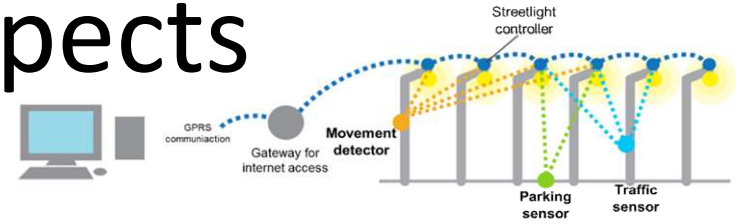
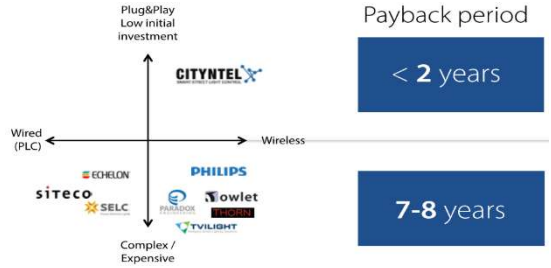
THINNECT
creating the Mist

Commercial aspects



- We offer & develop state of the art technology
- First solutions are operational in 5 countries
- We have a strong value proposition to our partners
- We work with industry leaders



SK telecom
NORDIC SEMICONDUCTOR
CYPRESS
OPEN INTERCONNECT CONSORTIUM
ALIEN
MARVELL
PHILIPS
NXP
MONSANTO
Texas Instruments
maxim integrated
ATMEL
MICROCHIP
ABOV SEMICONDUCTOR

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Supervisors

- Jürgo Preden, senior researcher
- Andri Riid, senior researcher
- Erki Suurjaak, engineer
- Johannes Ehala, PhD student
- Jaanus Kaugerand , PhD student
- Sergei Astapov, PhD student
- Raido Pahtma, PhD student
- Timo Tomson, PhD student








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Thesis topics (WSN)

- Location aware WSN node
  - Wireless sensor network node with GPS
  - Dynamically deployed WSN node determines its locations and operates based on location
- Cross standard WSN node
  - Wireless sensor node with Bluetooth LE and 802.15.4 interface (based on CC2650)
- Smartphone interface to WSN
  - 802.15.4 bridge with Nordic NRF52
- WSN node performance comparison
  - Run various real-worl algorithms on real WSN nodes

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Thesis topics (signal processing)

- Source separation technicques
  - Separating several signal sources from a single signal (separating 2-3 acoustic, vibration, ECG signals) in Matlab
- Acoustic signal de-noising using multiple microphones
  - concentrating on a specific sound source position and attenuating the sounds from other sources and ambient noise in Matlab
- Fitness metrics in multidimensional cluster analysis
  - study and/or propose own metrics for clustering in order to increase clustering quality
- Optimal color space for recognition of given object

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Thesis topics (robotics)

- Self aware robotic car
  - A robotic car, which follows an object emitting a certain sound
- Pattern (face) recogniction from images
  - Recognizing a specific pattern (e.g. face) from an image using an off the shelf librarry like Open CV (Android)
- Live object tracking
  - Tracking a user-selected object in a vide feed (Android)
- Fridge camera system
  - Camera system for reconigzing contents of a refrigerator

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Thesis topics (networking)

- Distributed Tracking Using Ultrasonic Sensor Grid
  - distributed sensor grid using autonomous wireless ultrasonic sensor systems to determine the position and vector of a mobile object
- Modelling Emergent Behaviour Using Multiagent System
  - implement a distributed multiagent system consisting of heterogeneous cyberphysical systems (e.g. Raspberry Pi)
- Establishing a Local Grid for Wireless Sensor Network Nodes
  - sensor nodes become aware of other sensors' relative positions, creating spatial situational awareness (for data fusion)

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Thesis topics (various)

- Sub-millisecond time synchronization with COTS HW on local network
  - Time synchronization on COTS embedded hardware Raspberry Pi or BeagleBone Black
- Non-linear controller for swing type pendulum
  - Balancing a swing with dynamically moving masses
- Applying a seismic sensor
  - Evaluation of the properties of a COTS seismic sensor in a real-world applications
- Smart Indoor Lighting & Building Information Management Solution
  - Solution for smart control of indoor lighting

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Thesis topics (Situation Awareness)

- Situational information exchange application
  - Application for exchanging situational information between people using a GIS interface

ProLab thesis topics:
https://goo.gl/MBDucq

Control Lab
www.a-lab.ee

TALLINN UNIVERSITY OF TECHNOLOGY

Lõputööde teemad (automaatjuhtimise suund)

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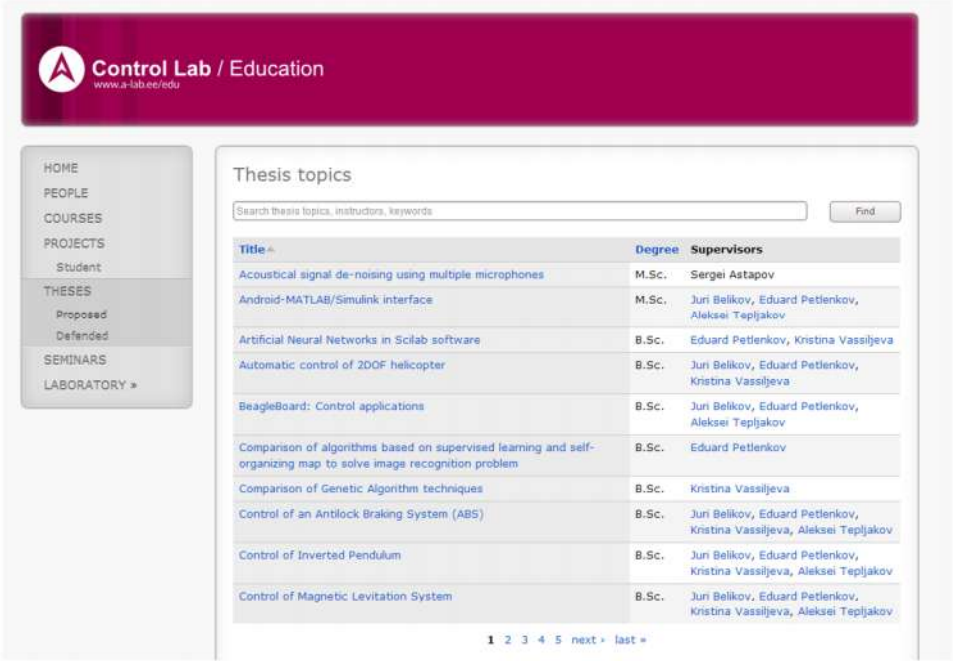
19. veebruar 2015 a.

Euroopa Liit
Euroopa Regionaalarengu Fond

Eesti tuleviku heaks

Lõputööde teemad



Lõputööde teemad: www.a-lab.ee/edu/

14.10.2015. seisuga 54 teemat

+ edukalt kaitstud tööd

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thnks

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Current projects

- **IN**formation **IN**teroperability & **IN**telligence **In**teroperability by **ST**atistics, **A**gents, **R**easoning and **S**emantics IN-4-STARS (European Defence Agency)
  - heterogeneous information fusion,
  - multi level security
  - semantic interoperability
- Sensor, information processing, exchange and visualization methods for ISR applications (Estonian Ministry of Defence)
- Signal processing for ISR (US Army Research Laboratory)