Machine vision in the Czech Republic

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About the speaker - Václav Hlaváč

• Born 1956, male, Ph.D. 1987
Prof. of the Engineering Cybernetics 1998
• Head of the Center for Machine Perception at
Faculty of Electrical Engineering since 1996
• Co-founder of CIIRC in 2013, leads its Robotics
and Machine Perception dept.
• Interest: autonomous robotics, computer
vision, machine learning.
• Responsible for the study branch Robotics at
the Faculty of EE ČVUT.
2015 World bank data

- Manufacturing, value added (% of GDP)

<table>
<thead>
<tr>
<th></th>
<th>Israel, Italy, USA</th>
<th>Japan</th>
<th>Germany</th>
<th>Czech Republic</th>
<th>China</th>
<th>South Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 World bank data</td>
<td>12%</td>
<td>19%</td>
<td>23%</td>
<td>27%</td>
<td>28%</td>
<td>30%</td>
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</tbody>
</table>

- Global manufacturing output
  - 55% China, Germany, Japan, USA (combined)
  - 45% The rest of the world

- Manufacturing sector contributing to Global Domestic Product
  - 1970: 25%
  - 2015: 15%
Tractica, computer vision market analysis
Industry 4.0 as a chance

DFKI – CIIRC ČVUT agreement on Industry 4.0 signed at our university on August 25, 2016

V. Hlaváč, CIIRC Czech Technical University in Prague
Project CloPeMa

Project TRADR

Project UP-Drive

• Automated Urban Parking and Driving. EC funded, 2016-2019.

• Coordinator Volkswagen Research, Wolfsburg, Germany.

• UP-Drive contributes to a selfdriving car.

• The first test scenario is “valet parking”, i.e. the car should drive autonomously in the urban environment in low speed (up to 30 km/h), explore it to find a parking spot, park there. Later, if called, it should drive to the position, where the human left the car.

• CIIRC team contributes to perception and scene understanding in the UP-Drive project
Computer vision academics, main groups

• Czech Technical University in Prague
  • Faculty of Electrical Engineering - Jiří Matas, Tomáš Svoboda, Boris Flach
  • Czech Institute for Informatics, Robotics and Cybernetics - Václav Hlaváč, Tomáš Pajdla

• Masaryk University Brno, Faculty of Informatics – Michal Kozubek

• University of Technology Brno, Faculty of Electrical Engineering and Communication technologies – Karel Horák

• Technical University Ostrava, Faculty of Electrical Engineering and Informatics – Eduard Sojka

• Technical University Liberec, Faculty of Mechatronics – Petr Tůma

• Czech Academy of Sciences, UTIA – Jan Flusser, Filip Šroubek
Principal theoretical contributions

• 1990
Jan Flusser – moment invariants, discovered mistake in Hu’s invariants, series of contributions on the topic

• 1995
Tomáš Pajdla (Václav Hlaváč as Ph.D. supervisor) – epipolar geometry and reconstruction for omnidirectional cameras

• 2002
Štěpán Obdržálek, Jiří Matas, Ondřej Chum, Tomáš Pajdla – maximally stable extremal regions
Labor force in computer vision

Source: Eastern European Computer Vision Conference 2016
CV industrial scene in the Czech Republic

R&D divisions of global companies

- Honeywell Research Labs in Prague
- Honeywell Development Center in Brno
- Valeo R&D Center in Prague

Local companies, see next slides
Czech CV companies (a)

Camea s.r.o. Brno, est. 1995, ≈ 80 employees, based on the own R&D

- [http://www.camea.cz](http://www.camea.cz)
- Intelligent transportation, car speed measurements (most of Czech market, pattern recognition part subcontracted from Eyedea Recognition s.r.o.) trucks weight measurement while driving
- Industrial applications
  - (Non-woven) fabric inspection, line cameras, speed 2000 m/min, i.e. 120 km/h, defect size 0,1 mm², 5 meters width.
- Bottle inspection
- Label inspection, e.g. on trains in full speed
UIC code reader – train identification system
UniscanDETECTOR continuous strip inspection

Examples of defects

- **Foil**

- **Non-woven fabric**

- **Paper**

- **Metal**

Central server
Server handles mainly control of the whole measuring process and communication with particular subsystems. Furthermore it processes image data and archives results of inspection.

Operator console
According to needs it’s possible to use several remote administrator consoles and multiple offline stations for reviewing of archived reports.

Connection to other systems
Connection to other systems of production line (PLC, encoder, database, printer, etc.) via standard industrial interfaces is commonplace.

Output devices
It’s possible to signal (acoustic or optical alarm, marking system) not only actual state of system, but also occurrence of selected types of defects.
Czech CV companies (b)

Eyedea Recognition s.r.o., Prague, spin-out of ČVUT, est. 2006

- [http://www.eyedea.cz](http://www.eyedea.cz)
- Human face detector, gender, age estimator
- Eye motion analysis
- Car make and model recognition
- Car number plate reading.
- Image data anonymization
- Video matching
EYEDENTITY

- Forensic software for face recognition in photos and videos.
- Used also by EUROPOL and Police of the Czech Republic.
Vehicle Make and Model Recognition

MMR Software recognizes:

• **70 Makes**: Citroen, Audi, Volvo, Scania, ...
• **500 Models**: VW Golf, Renault Megane, ....
• **5 Categories**: Car, Van, Bus, Light Truck, Heavy Truck, MTB
• Color
• Both from frontal and rear view.

www.eyedea.cz
Czech CV companies (c)

ATEsystem s.r.o., est. 2013
• http://www.atesystem.cz
• Industrial inspection

Workswell s.r.o.
• https://www.workswell-thermal-camera.com/
• Infrared cameras, services also on drones
Czech CV companies (d)

ELCOM, a.s., Ostrava, est. 1990
• [http://www.elcom.cz](http://www.elcom.cz)
• Relevant is its Division of Virtual Instrumentation
• Vision inspection in industry

Kinalisoft s.r.o., Brno, est. 2006
• [http://www.kinalisoft.eu](http://www.kinalisoft.eu)
• Computer vision applications in different areas
Thank you for the attention.

Questions?