

Chapter 1: Introduction

Smart Cameras and Visual Sensor Networks



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Course Information

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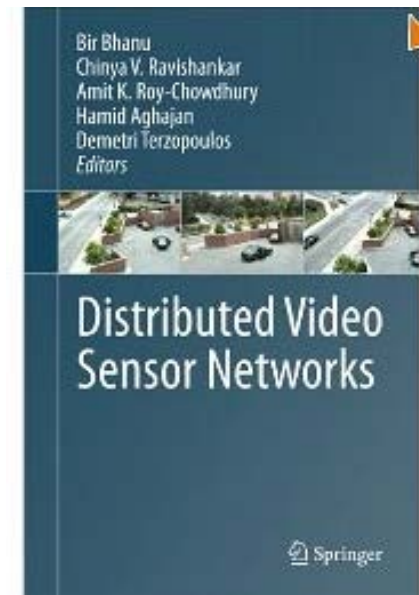
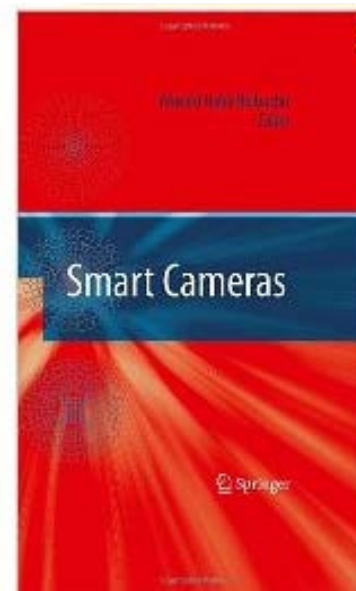
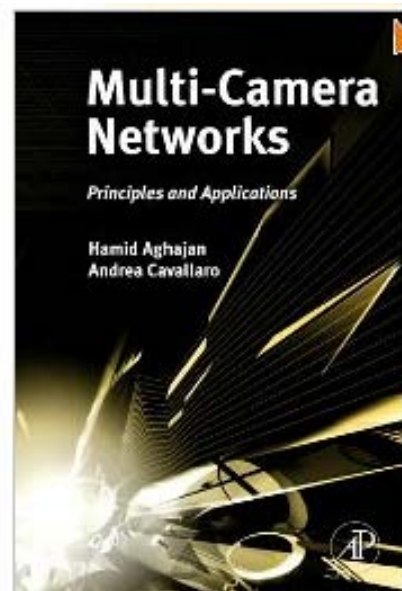
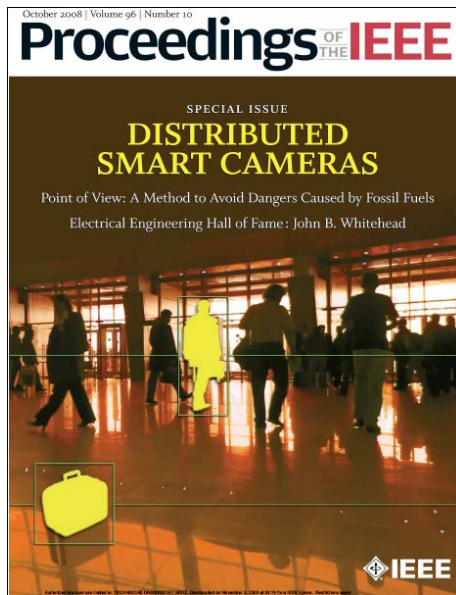
- Tutorial site

Most recent course material is available at

<http://pervasive.aau.at/S5-tutorial>

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Selected Key Literature



- Check also references in Chapter 5

Dedicated Scientific Events

- ACM/IEEE Int. Conf. Distributed Smart Cameras (ICDSC)
Oct 29-Nov 1, 2013 Palm Springs/USA www.icdsc.org
- IEEE Int. Conf. Information Processing in Sensor Networks (IPSN)
Apr 8-11, 2013 Philadelphia, USA www.cpsweek.org
- IEEE Workshop on Embedded Computer Vision (@CVPR)
June 24, 2013 Portland, USA www.cvpr2013.org
- IEEE Workshop on Camera Networks & Wide Scene Analysis
June 28, 2013 Portland, USA www.cvpr2013.org
- IEEE Conf. Advanced Video and Signal-based Surveillance (AVSS)
Aug 27-30, 2013 Krakow/Poland www.avss2013.org
- ...

Revolution in Cameras

- Ongoing technological advances in
 - lenses
 - image sensors
 - onboard processing
 - networking
- transform camera as box delivering images into **spatially distributed** that generate **data and events**
- Huge amount of **visual information** is processed in a **network of resource-limited embedded** nodes in dynamic environment

Principle of Smart Cameras

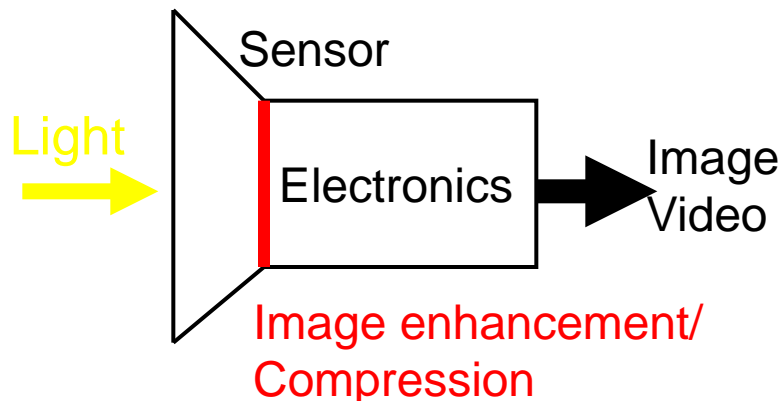
- Smart cameras combine
 - sensing,
 - processing and
 - communicationin a single embedded device
- perform **image and video analysis** in **real-time** closely located at the sensor and transfer only the results
- **collaborate** with other cameras in the network

Differences to traditional Cameras

Traditional Camera

- Optics and sensor
- Electronics
- Interfaces

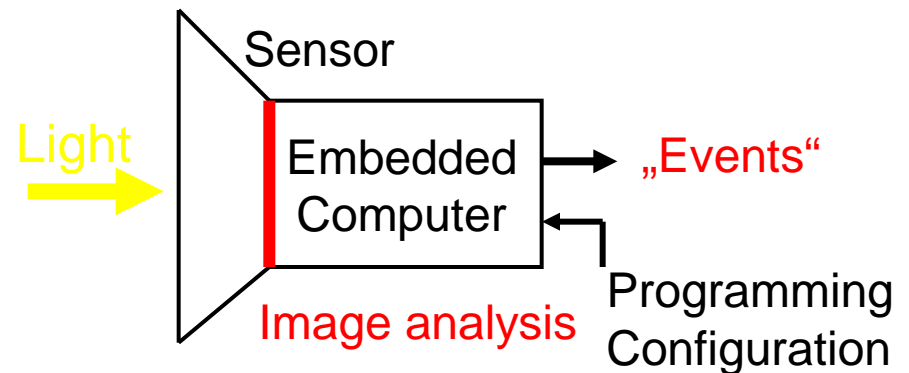
delivers data in form of (encoded) images and videos, respectively



Smart Camera

- Optics and sensor
- **Onboard computer**
- Interfaces

delivers **abstracted image data** and is configurable and programmable



SmartCams look for important things

- Examples for **abstracted image data**
 - compressed images and videos
 - features
 - detected events



Smart Cameras collaborate

- Connect autonomous cameras in a network
 - exploit smart cameras' capabilities (eg. avoid raw data transfer)
 - relax centralized/hierarchical structure of MC networks
 - introduce dynamic configuration (structure and functionality)
- Distribution of sensing and processing imposes several challenges
 - camera selection and placement
 - calibration & synchronization
 - distribution of data and control
 - (ad-hoc) networking
- Form a **visual sensor network**

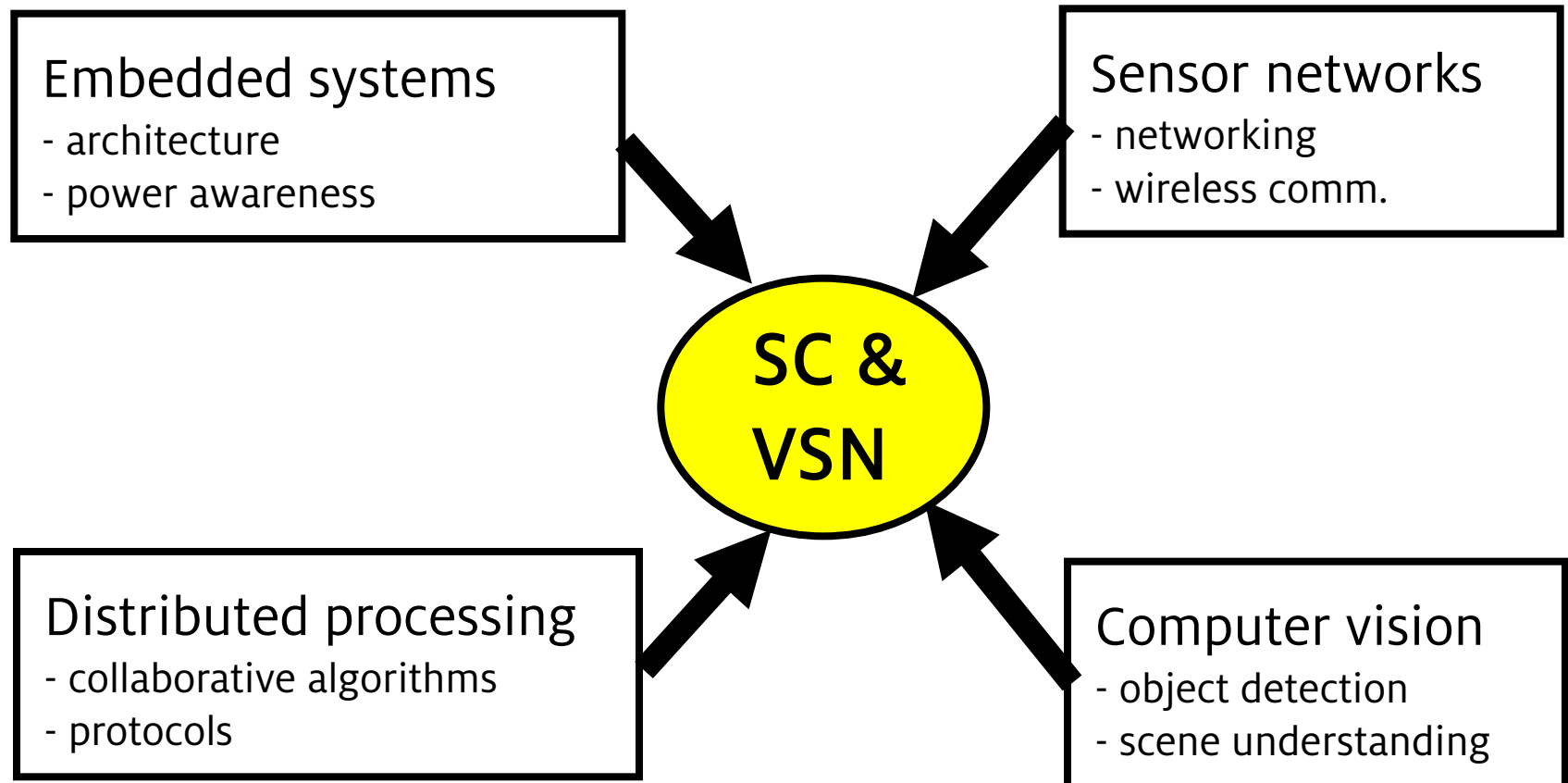
Smart Surveillance with VSN

- On-board and in-network Image/video analysis
 - real-time processing
 - embedded in larger systems
- Enabling new applications
 - smart home, smart building
 - interactive environments, AR systems
 - mobile camera networks
 - assisted living
 - ...

Advantages of Distributed SC

- Scalability
 - No central server as bottleneck
- Real-time capabilities
 - Short round-trip times; “active vision”
- Reliability
 - High degree of redundancy
- Energy and Data distribution
 - Reduced requirements for infrastructure; easier deployment
- Sensor coverage
 - Many (cheap) sensors closer at “target”; improved SNR
- ...

Multidisciplinary field



Aim of this Tutorial

- What this tutorial **is about**
 - Introduction to smart cameras and visual sensor networks
 - Selected examples of node- (camera-) and network-level aspects
 - Demonstration of case studies and applications
 - Discussion of open challenges
- What this tutorial **is NOT about**
 - Surveillance algorithms (detection, tracking etc.)
 - Comprehensive study of related work

Tutorial Agenda

1. Introduction

2. Smart cameras

- Architecture of Smart Cameras
- Prototypes

3. Visual Sensor Networks

- Advantages & Challenges
- Characteristics of Visual Sensor Networks
- Research Directions

4. Applications

- Security- and privacy-awareness in Smart Camera Networks
- Aerial Visual Sensor Networks

5. Conclusion