

Image and Signal Analysis with Applications in Health Care

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Introduction

Summary

Sensing, analysis and understanding of human behavioral, communicative and biological signals. Looking and understanding people activities.

Modalities: Vision, Electroencephalogram (EEG), Heart rate,

Challenges

Signal extraction, Analysis, Understanding

Applications

Gaming, Health Care, Human Machine Interaction, Intelligent Systems, Multimedia Analysis, Ambient Intelligence

Related expertise

Computer Vision, Signal Processing, Pattern Recognition

Related research

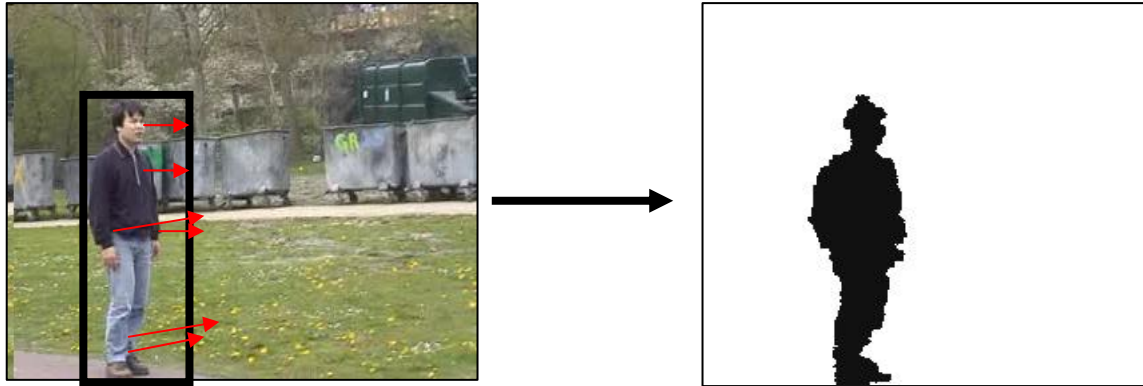
Looking/sensing people

- **Detection and Tracking** (1997-2007)
Head / Facial Feature Tracking (Pogalin, Jones, Pantic)
Object Tracking (Hancock)

Understanding people

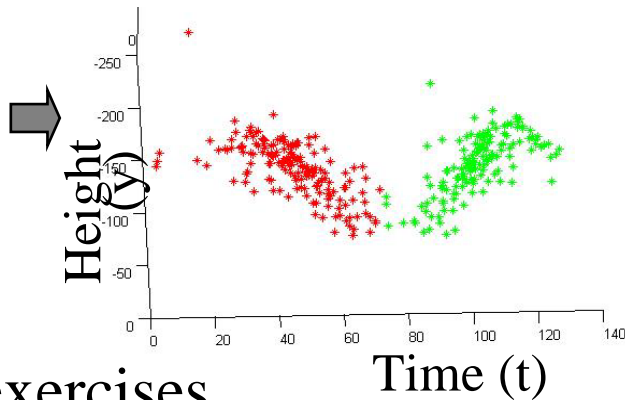
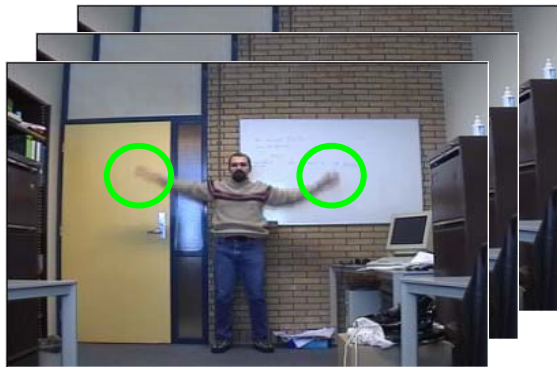
- Facial (Expression) Analysis (2002-2005)
Facial expression recognition (Pantic, Valstar)
- **Object / Gesture Recognition** (2001-2007)
Color-shape representations for object recognition (Diplaros, Gevers)
Spatio-temporal representations for action recognition (Oikonomopoulos, Pantic)
- **EEG/Vision for HCI** (2008 -)
(Koelstra)

Human Detection, Tracking and Motion Analysis



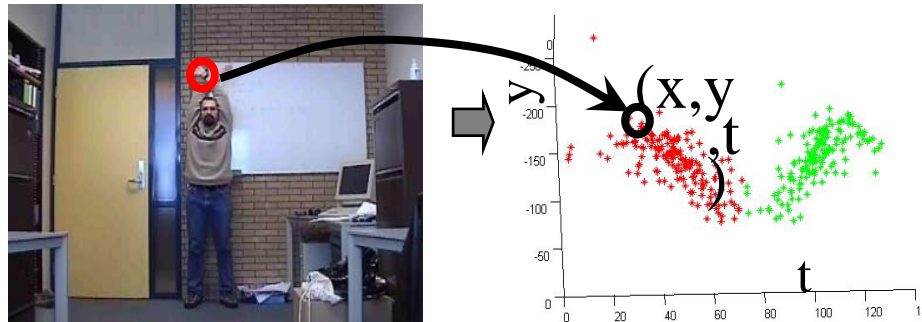
- Low level analysis for extraction of shape and motion descriptors
- Pattern analysis allows activity recognition and quantification
 - What, Where, Who, When, How
- Health care (intelligent spaces): assessment of critical situations, level and types of activities, influence of drug use etc.

Human Action Recognition



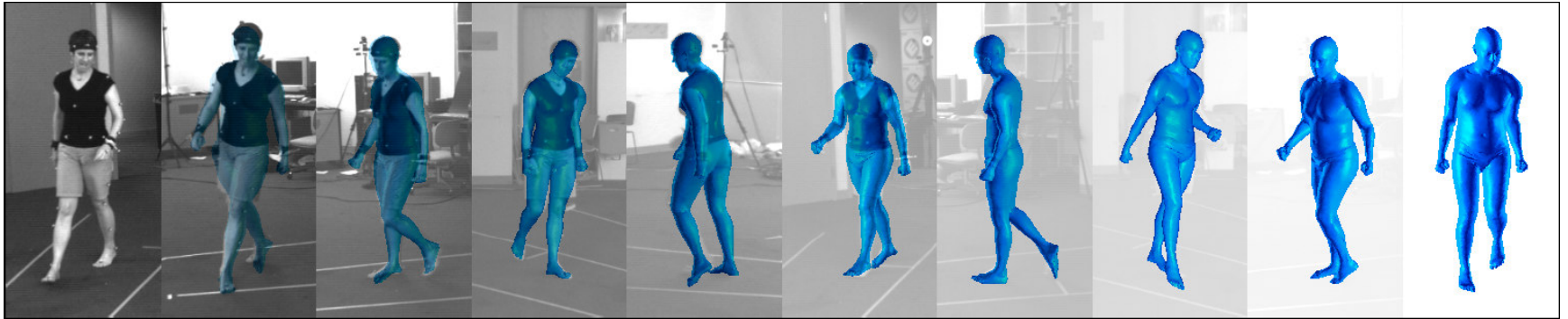
- Recognition of aerobic exercises.
- Health care: Exercise in a home environment, personal trainer
Ageing population
- Relatively easy: known number of well defined actions
- Issues: on-line training and adaptation, personalisation

Activity recognition



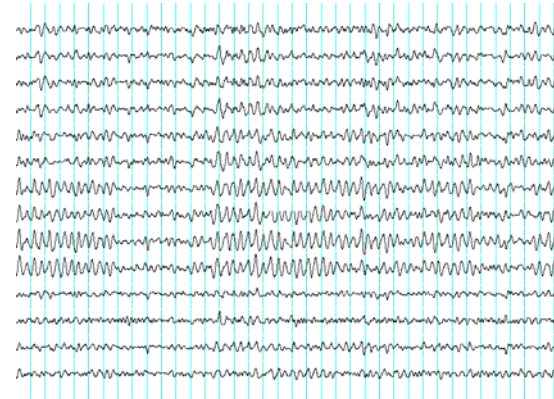
- Feature extraction and classification for exercise recognition
- Health care: personal trainers, assessment of critical situations, level and types of activities, influence of drug use etc.

Pose and Shape Analysis



- In controlled environments detailed models of 3D pose and shape
- Camera network (calibration, communication, fusion)
- Angles between body limbs + body shape (over time)
- Health care: Gait analysis (tiredness, pain, discomfort), prosthetics.

Brain Computing

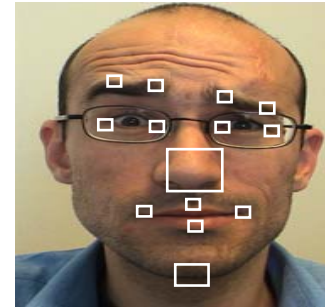


- One (or two-way) direct communication with the brain
- Healthy user applications (e.g. gaming)
- Health care applications: Neuroprosthetics (e.g. control of robot arms), spelling, detection of emotional/physiological state (e.g. agitation, pain)
- Mental disorder detection: Seizure detection (in combination with video, HR, respiration), dementia

Facial Analysis

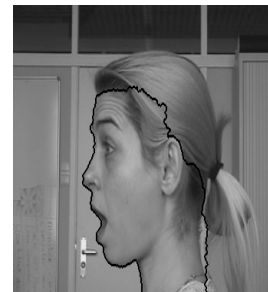
Facial Feature Tracking

Face and Gesture Recognition 2004



Profile Expression Recognition

ICME 2002, ICME 2004

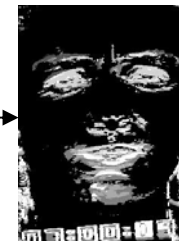


**Raised eyebrows
Dropped Chin**

Surprise

Frontal Expression Recognition

Human Robot Interaction 2004,
Systems, Man, and Cybernetics 2004



**Pressed lips
Lowered eyebrows**

Challenges and opportunities

- Challenges in signal acquisition, transmission, filtering and analysis.
- Multimodal analysis, i.e. fusion of information from various sources. Communication, coordination issues.
- Biomedical signals (Heart rate, skin conductivity, EEG) + vision
- Robustness (e.g. assessment of tiredness, pain, seizure)
- Added information (e.g. correlate biomedical signals with visual information)