Excursion Report

Applications of Image Processing
Winter semester 08/09

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PATTERN RECOGNITION AND IMAGE PROCESSING GROUP

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Contents

Baggage Handling

Patrick Magnusson

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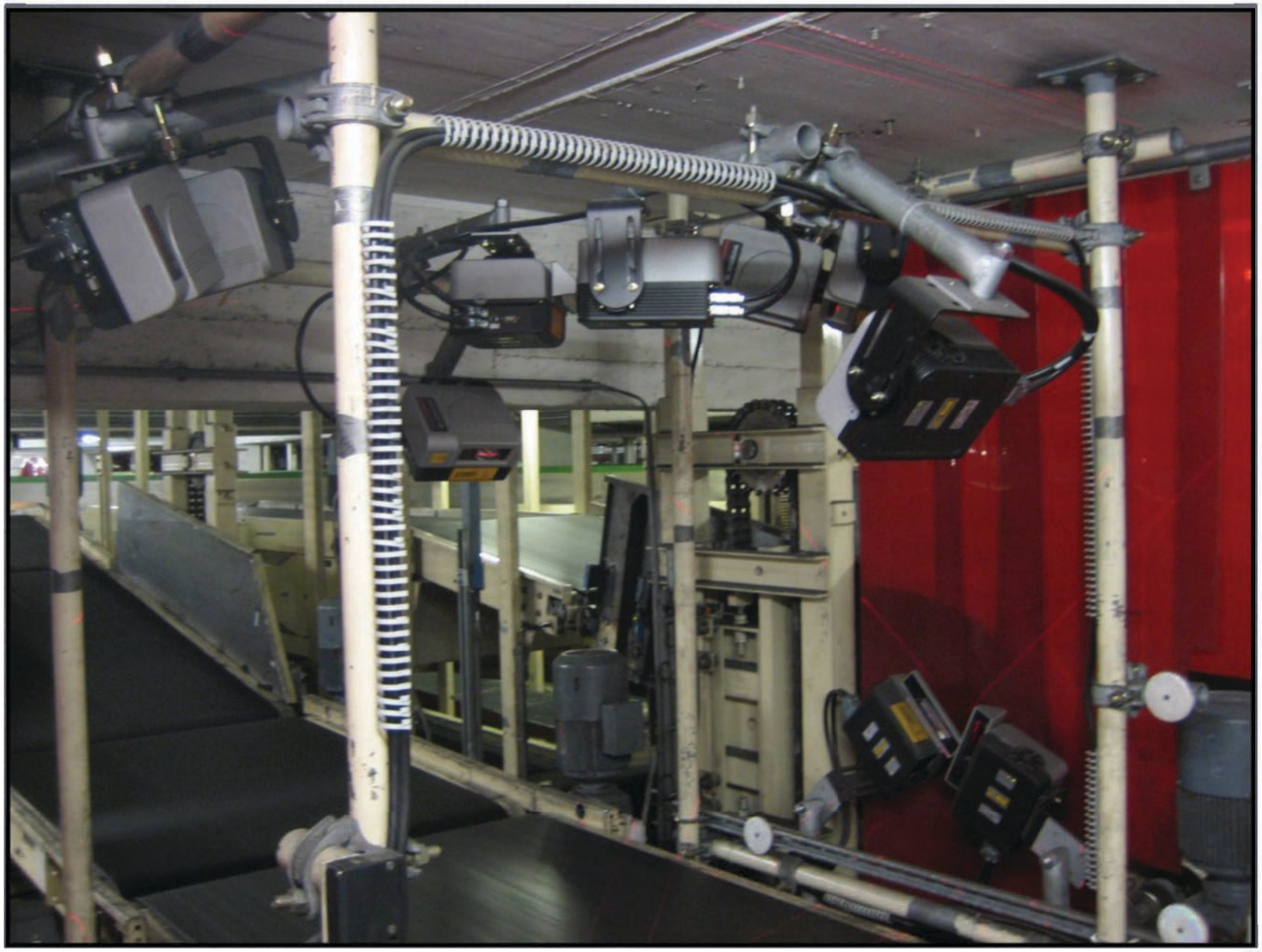
Baggage Handling



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Baggage Handling

AUTO ID Data Capture (AIDC) and Barcode Scanners

Fatih Ugur

Fatih Ugur

AUTO ID Data Capture (AIDC) and Barcode Scanners

- Auto ID
  - > Identifying the objects automatically
- Data Capture
  - > Getting information about the objects
- AIM :
  - > Using the information depending on our needs
- AIDC Technologies :
  - > Barcodes, RFID, Magnetic stripes, Smart cards..

AUTO ID Data Capture (AIDC) and Barcode Scanners

- Barcodes
  - Definition : Optical machine readable representation of Data
  - Earlier : Representing data with parallel lines
  - Later on : Geometric patterns (hexagons, dots etc.)

- Use of Barcodes

  - Widespread
  - Groceries, department stores, document management..
  - Tracking (Airline Luggage)

AUTO ID Data Capture (AIDC) and Barcode Scanners

- Scanners (Barcode readers)
  - > Important : The connection to the computers
  - > Older types needed programming to transfer the data
  - > USB barcode scanners are more modern
    - Easy Installation
    - Programming is not needed, easy to use

Fatih Ugur

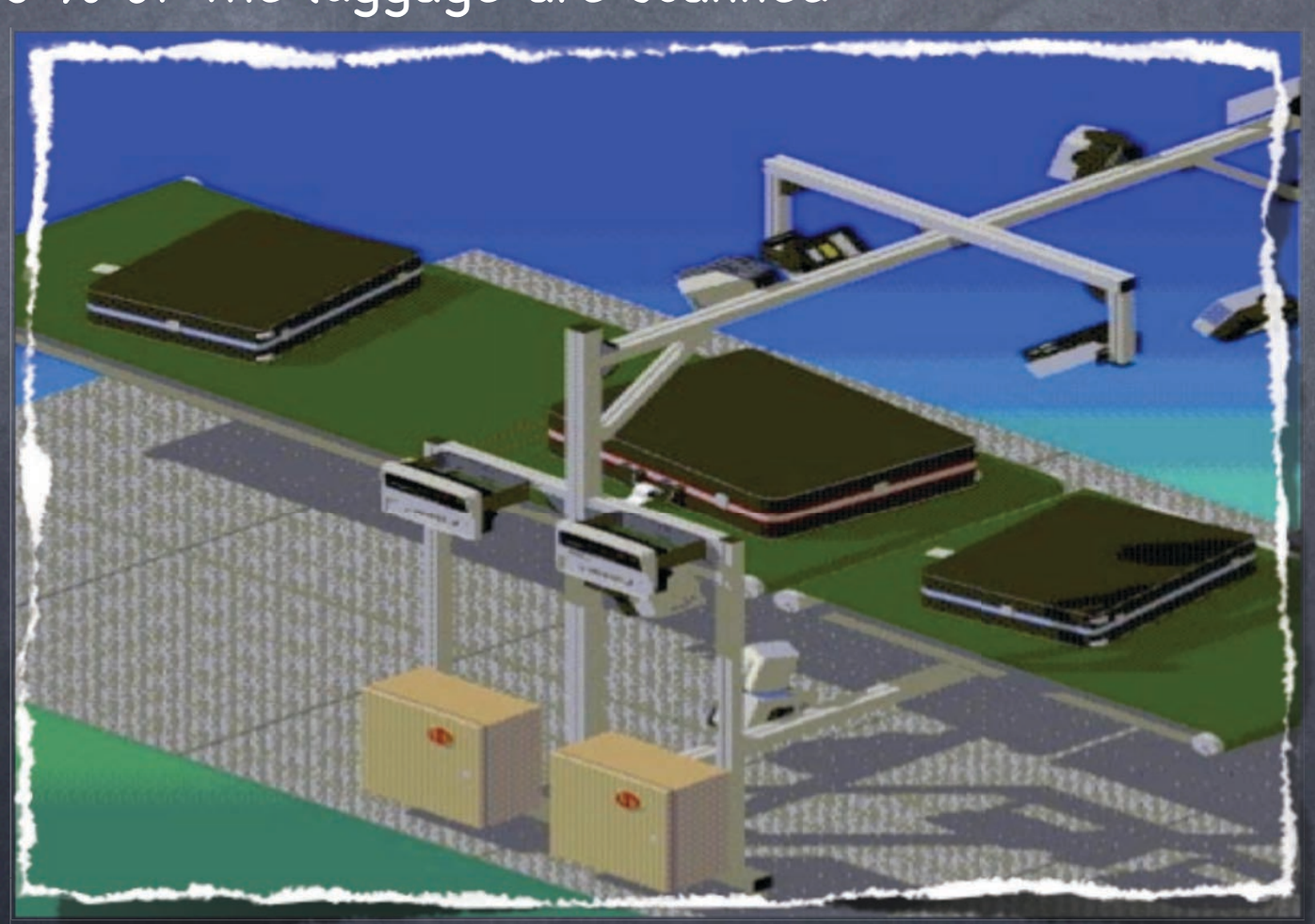
AUTO ID Data Capture (AIDC) and Barcode Scanners

- Bag Tags
  - Traditionally used by bus, train and airline companies
  - Aim : Routing of passenger luggage

- Bag Tags in Airports
  - A unique 10 Digit number (Barcode)
  - Includes the flight information
  - Availability of getting the travel route

AUTO ID Data Capture (AIDC) and Barcode Scanners

- 360 Degrees Barcode Scanners
  - Automated array of scanners arranged 360 degrees
  - 90 % of the luggage are scanned



AUTO ID Data Capture (AIDC) and Barcode Scanners

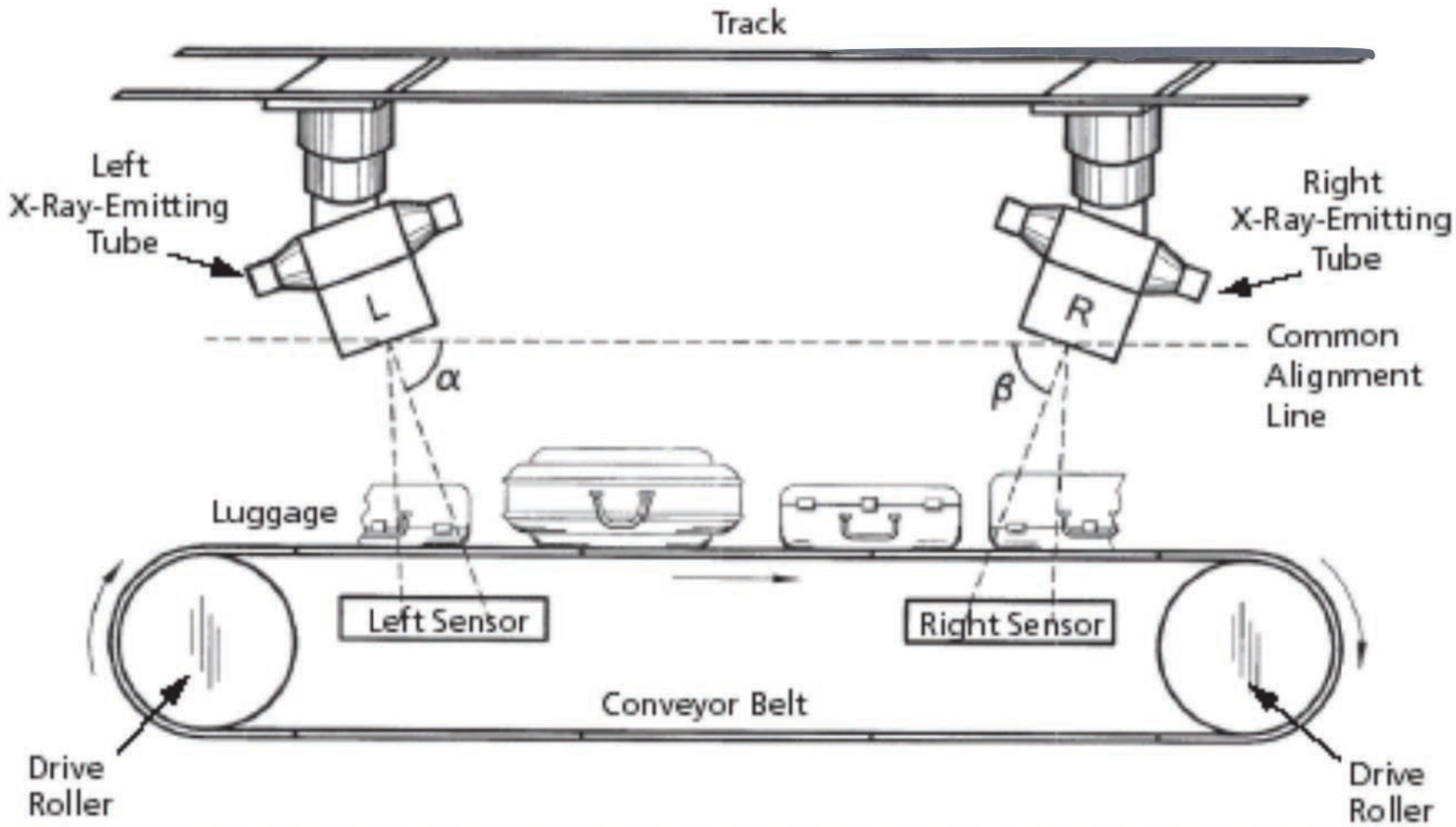
- 360 Degrees Barcode Scanners
  - Advantage
    - Once the barcode is scanned, tracking is possible
  - Disadvantages
    - Poorly printed or damaged barcodes
    - Direct sight is a must
    - 100 % Read rate is impossible
    - Flights with transfers => Lower read rate

AIP - Excursion

X-Ray for airport applications

Raphaël Valensi

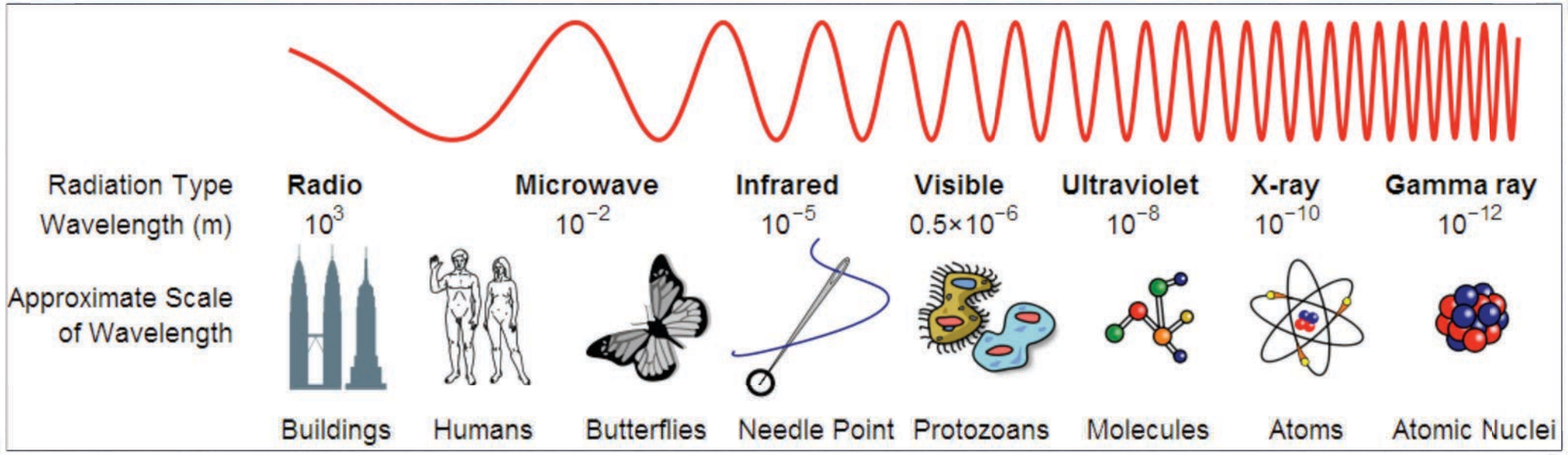
X-Ray for airport applications



Images From the Left- and Right-Eye X-Ray Sensors are captured at different locations and stored along with conveyor position data allowing the appropriate left- and right-eye images to be viewed by the human operator on a commercially available stereo display screen.

X-Ray for airport applications

- X-Ray Definition : Electromagnetic wave
- Properties:
  - Wavelength : 10^{-8} to 10^{-12} m
  - Wave Frequency : 30×10^{15} Hz to 30×10^{18} Hz



X-Ray for airport applications

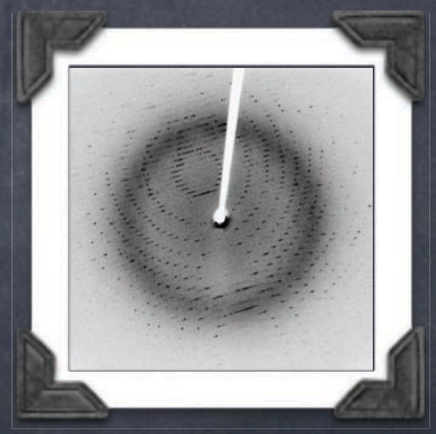
X-Ray : Flow of the photons

- Fundamental particles:
  - Small size : $8*10^{-16}$ m
- Electrostatic neutral particle:
  - Don't interact with polarised elements
- Large range of kinetic energy (depending of the frequency): for e-V to several Me-V
  - Can go across object (depending of the power source)

X-Ray for airport applications

Interaction of X-Ray with material

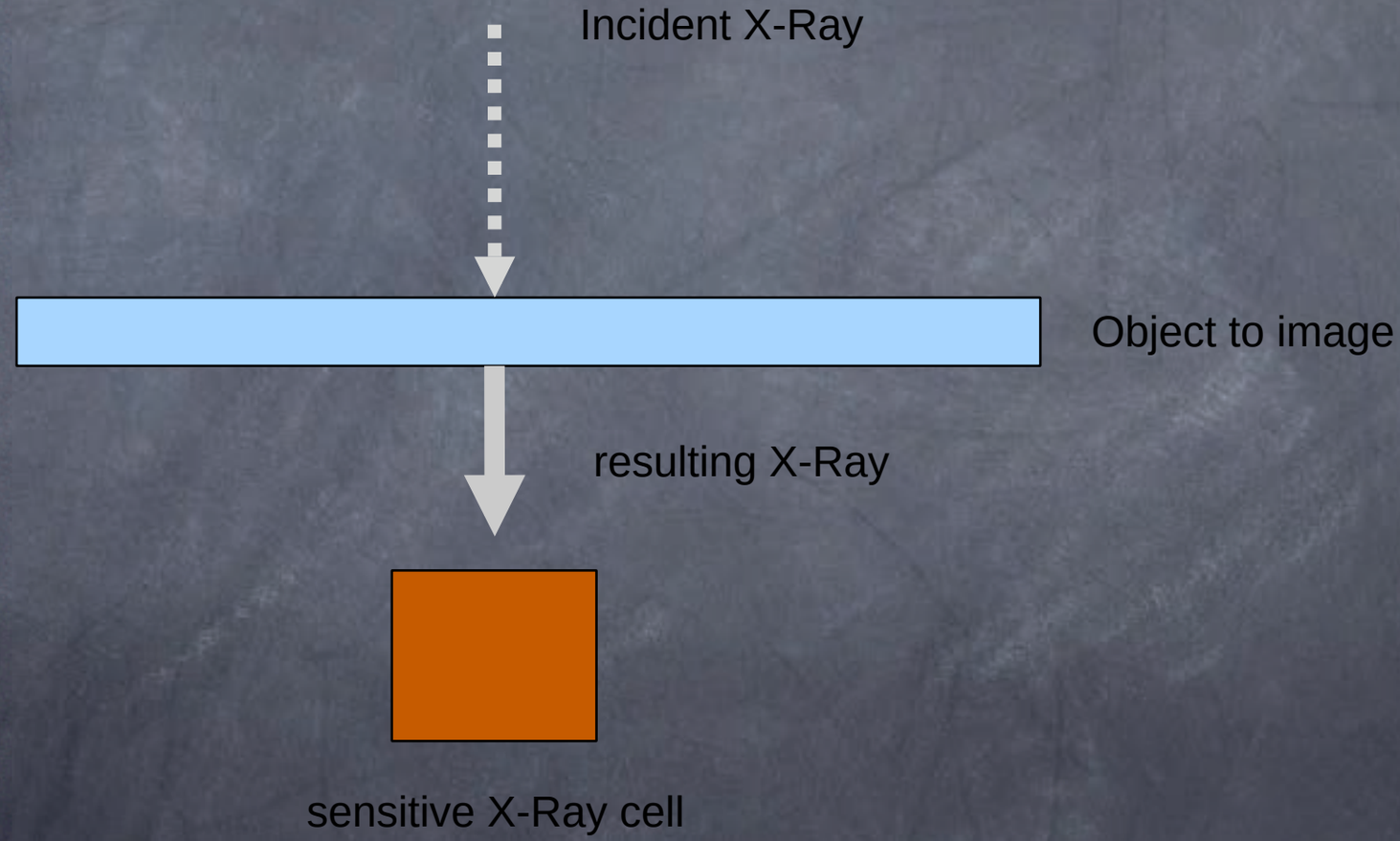
- Fundamental property of the X-ray imaging:
  Interaction between X-ray and material
  - Attenuation through a material: the energy intensity of the incident ray becomes lower after going across a material
    - First approximation : the x-ray absorption by the weak atoms lower than the absorption by the heavy atoms
- Diffraction :
  - Wave length of the X-ray comparable to the dimensions of atoms (angstroms) :Diffraction on the atoms networks



X-Ray for airport applications

Presentation of Different Techniques

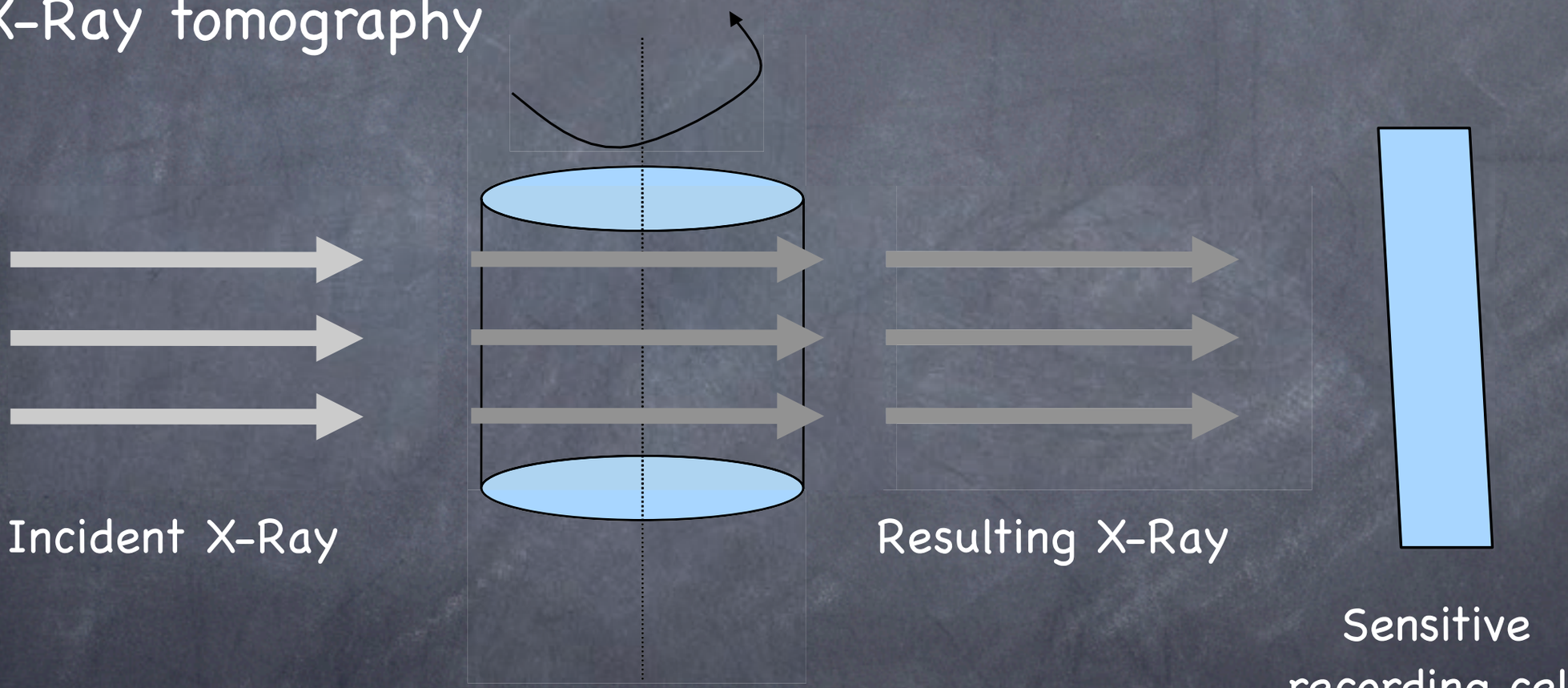
- Projection radiography



X-Ray for airport applications

Presentation of Different Techniques

- X-Ray tomography



X-Ray for airport applications

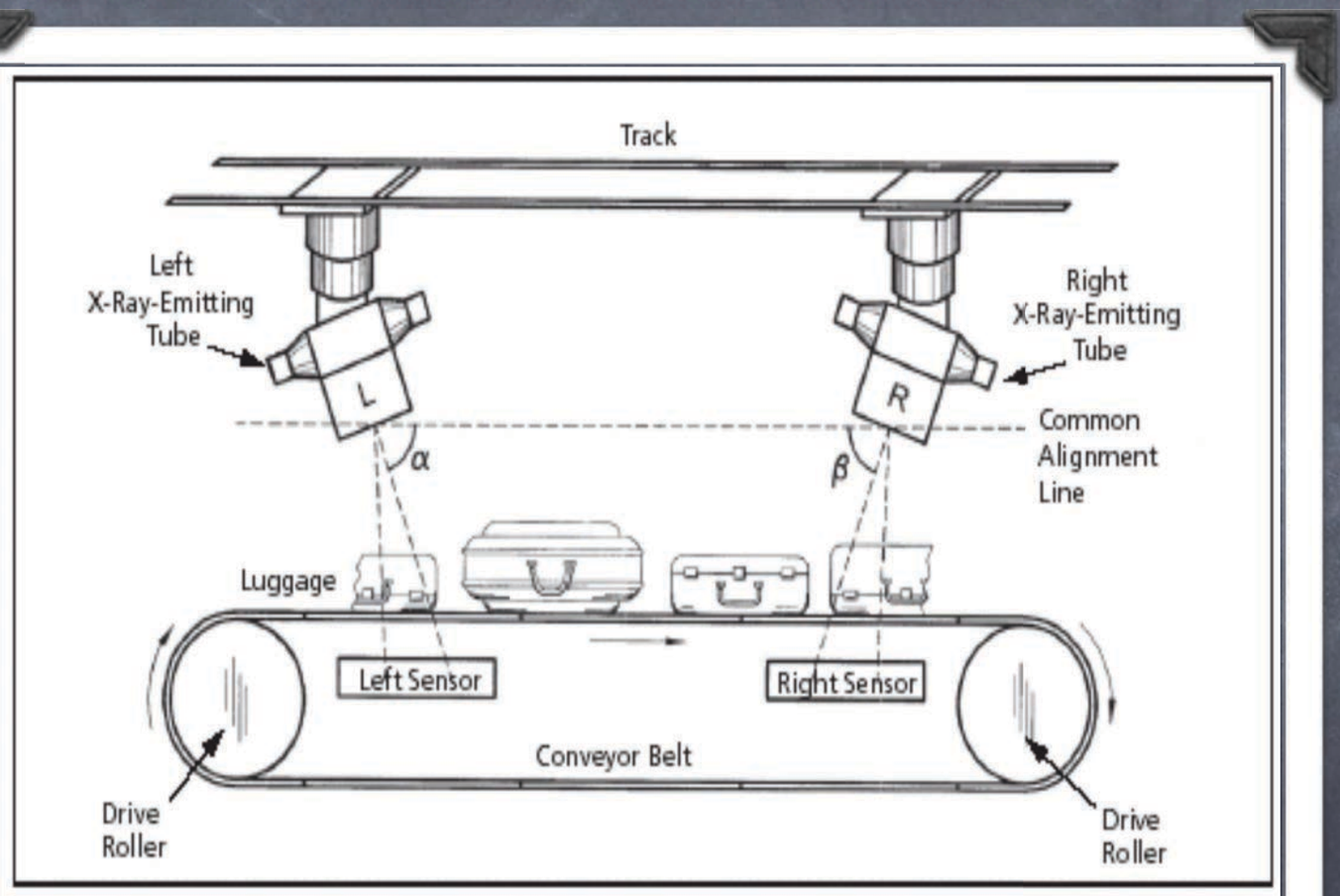
Advantages/Disadvantages of X-Ray Tomography

- Advantages compared to the projection tomography
  - Reconstruction of the volume
  - More accurate determination of the absorption of elements
- Disadvantages compared to the projection tomography
  - Time consuming method
  - Calculation consuming method
  - Longer exposition to the radiations

X-Ray for airport applications

Streoscopic X-Ray Screening

- Basic Idea



Images From the Left- and Right-Eye X-Ray Sensors are captured at different locations and stored along with conveyor position data allowing the appropriate left- and right-eye images to be viewed by the human operator on a commercially available stereo display screen.

X-Ray for airport applications

Advantages/Disadvantages

- Supply chain method (as opposed to the X-Ray Tomography)
- Much more comfortable for operators than the simple X-Ray projection radiography
- Limitations of exposition time to the X-Ray

X-Ray for airport applications

Conclusion

- X-Ray imaging is since decades in airports a widely used tool
- Still research on signal processing/pattern recognition for standard methods (noise filtering, computed tomography algorithms, automatic object recognition..)
- Researches on the applications of principles on new physical principles (X-Ray diffraction for the detection of illegal substances)

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AIP - Excursion

Iris Recognition

Christian Johannes Tomaschitz

Iris Recognition

Why Iris Recognition ?

- Iris
  - Prenatal phase
  - Growing
  - Forming and Folding
    - gets unique like the finger print

Iris Recognition

What are the steps ?

- Two Phases
  - Preparing of recognition
    - Locating the iris
    - Detection of land marks
  - Executing the recognition
    - High resolution photo
    - No noise (eyelashes)

Iris Recognition

Algorithm :

- Main parts
  - Extract the features
  - Transformation of pixels in bit patterns (Gabor wavelet transform)
  - Statistical analysis

Iris Recognition

How Iris Recognition used at airports ?

Purpose	Installed at location ...
Iris as passport	Amsterdam, Frankfurt
Processing and checking for departing passengers	Boston, Los Angeles, Minneapolis, Houston
Airline Crew facility access	Charlotte Douglas
Airport employee access to restricted areas	New York, Albany, Frankfurt, Amsterdam, Canadian Airports
Watch List Screening	Arab Emirates, 7 airports

Iris Recognition

Advantages / Disadvantages :

- Advantages of Iris Recognition
  - Internal organ - so protected against external influences
  - Iris is flat
  - Fine texture like finger prints
- Disadvantages of Iris Recognition
  - Fingerprint recognition is more usual field
  - Iris recognition is hard to make for a larger distance
  - Bad quality images the performing worse

Iris Recognition

Conclusion :

- Iris recognition used on airportsal influences
  - All five Heathrow terminals
  - Manchester terminals 1 & 2
  - Birmingham terminal 1
  - Gatwick North and South terminal
- Different hardware setups are available
- Trend is expansion of the iris system
- Fast recognition high reliability

AIP - Excursion

Face Recognition

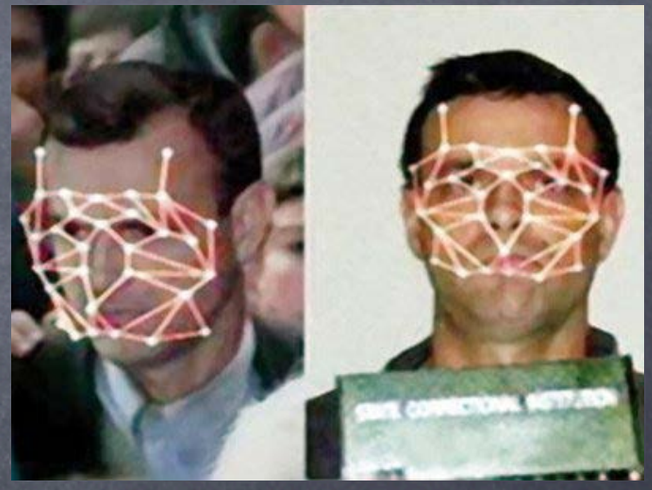
Daniel Moreto

Daniel Moreto

Face Recognition

- Target: identify people in images
  - Photography
  - Video (surveillance,etc.)

- Usage of obtained pictures
  - Extract patterns
  - Compare with database
- Main Problem
  - How to analyze a face from a picture
  - Compare with many other pics efficiently



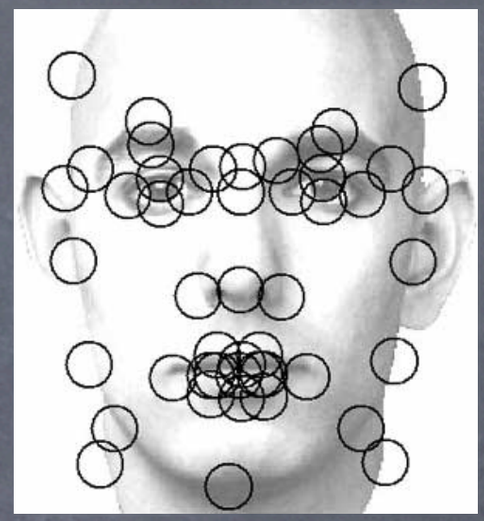
Face Recognition

- Advantages
  - No need of cooperation
    - Contrast with other biometric recognition
  - Can be recognized without noticing it

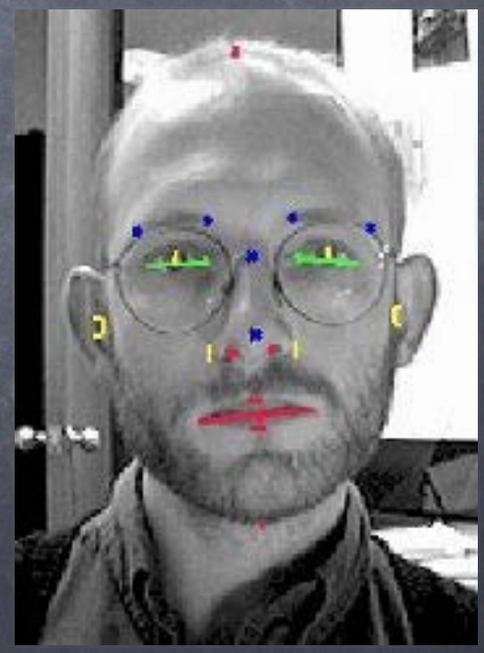
- Disadvantages
  - 2D Scanning of a 3D Figure
    - 3D Technology is being developed
  - Need high resolution
    - Not very common, but can be improved

Face Recognition

- Algorithms
  - Principal Components Analysis (PCA)
    - Normalized Images
    - Decomposes facial image to eigenfaces (orthogonal components)



  - Linear Discriminant Analysis (LDA)
    - Between trained samples (autentication)
  - Elastic Bunch Graph Match (EBGM)
    - Non linear properties
      - Illumination, face positions, expressions...



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Face Recognition

- Improvements
  - 3D Scanning
  - Texture analysis (20-25% Better)
- Usage
  - Airport
  - Mexican presidential election
  - Superbowl 2001
- Future ?

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Fingerprints Recognition

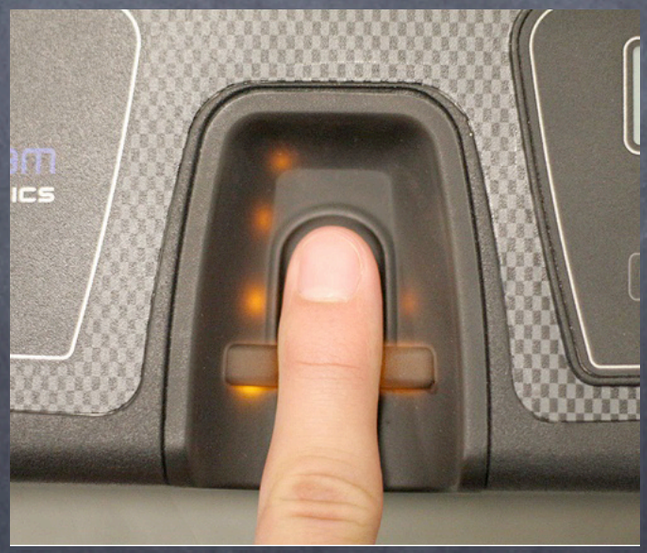
Gonzalo Mendoza Cortes

Fingerprints Recognition

- Identification system for security institutions
  - e.g. Police, Access control
- Features
  - Uniqueness of every person's fingerprint
  - Invariability through time
  - A Lot of experience in the field (since 1982)
- Problematic
  - Needs physical contact, which can lead to noise

Fingerprints Recognition

- Hardware
  - Optical sensors
  - Capacitance sensors
    - Passive
    - Active
  - Ultrasonic sensors
  - Thermic sensors

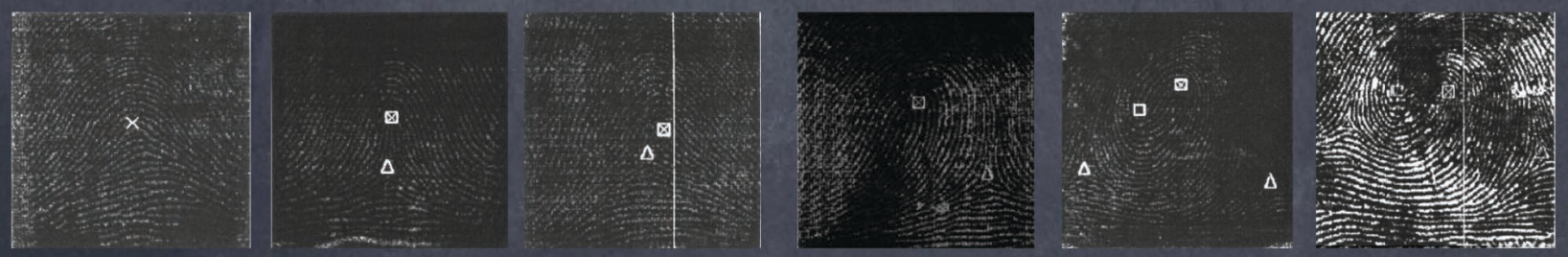


Gonzalo Mendoza Cortes

Fingerprints Recognition

Process : based upon Minutiae, features of Fingerprints

- Minutiae Extraction
  - Six different finger patterns : Arch, Tented Arch, Left Loop, Right Loop, Twin Loop and Whorl
  - Ridges, Deltas and Cores
  - A pair of Fingerprints are needed : Input and Database
  - Rhao Method, which works out gradients Gx(i,j) and Gy(i,j)
  - Creation of the Fingerprint Map



Fingerprints Recognition

Process : based upon Minutiae, features of Fingerprints

- Minutiae Comparison
  - Previous aligning phase
  - Then every minutiae is converted into polygons based upon the polar coordinates
  - Finally a series of matching algorithms are applied
    - Not applied to the Minutiae itself but the ridge
  - Optimization through Hough Transformation

- Formats
  - ANSI/ICTS, ISO/IEC, ISO/FCD; WSQ,JPEG

Gonzalo Mendoza Cortes

Fingerprints Recognition

- Problems, Noise and Solutions
  - Inkless scanners
  - Not matching Minutiae
  - Broken and Spiked Ridges and Minutiae :
    - Smoothing Process :
      - Heuristic
      - Stepwise refinement based on Structural Information
      - Readjustment of the information added to the Minutiae

AIP - Excursion

Whole Body Imaging

Karin Straka

Karin Straka

Whole Body Imaging

- Scanning persons for detection of weapons,explosives, other threat items
- Advantages to other methods:
  - No physical contact necessary
  - Detection of non metalic weapons possible
- Problematic :
  - Violation of privacy
  - Data security
  - Effects on health

Whole Body Imaging

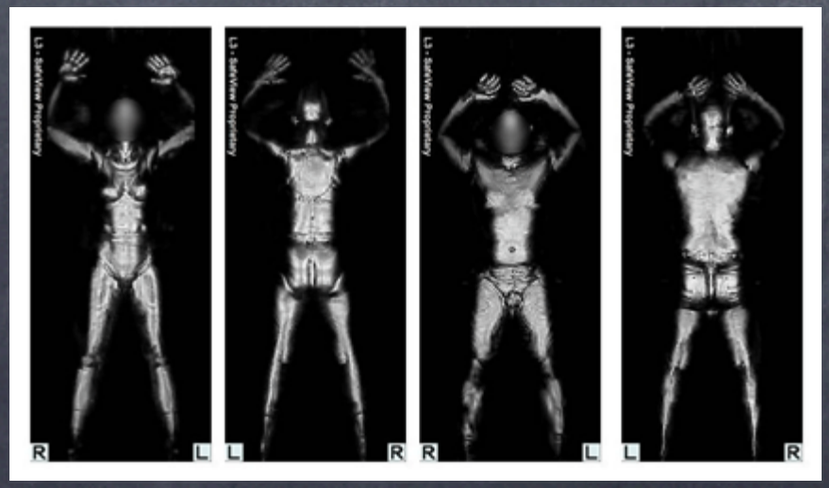
- 3 Different Technologies
  - Backscatter
  - Millimeter Radiation
  - Terahertz Radiation

Whole Body Imaging

- Backscatter
  - X-Rays
  - Difference to X-Rays in medicine
    - Detectors for scattered energy
- First tests already in 2002
- Dose of radiation : not higher than flying two minutes at cruising altitude

Whole Body Imaging

- Millimeter Radiation
  - Microwaves with wavelength between 1 and 10 mm
  - Passive method
    - Energy emitted by the scanned person is measured
  - Active method person is scanned with beams of mm energy
  - Advantage to backscatter :
    - Radiation has no bad effects on health



Whole Body Imaging

- Terahertz Radiation
  - Submilimeter radiation between 100µm and 1mm (between Microwaves and Infrared)
  - Ability to penetrate deep into many organic materials
  - Materials have unique spectral "fingerprint" in this range
  - Readily absorbed by water
  - Problems :
    - Heavily sweating persons
    - Aluminium Luggage

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AIP - Excursion

The Future of Image Processing on Airports

Viktor Eriksson

Viktor Eriksson

The Future of Image Processing on Airports

- "Barrier free" Map
  - Navigation system for wheelchairs
    - toilets
    - information desks
    - where steps are located
- Improving the detection of low density weapons
- RFID-Chip that enables person monitoring
  - Connected to surveillance cameras

Viktor Eriksson

The Future of Image Processing on Airports

- Face expressions
  - Specific sets of muscles under the face near the eyes,nose and mouth
- Automated Visual Control
  - Monitor aircraft maneuvering
- Advanced Surface Movement Guidance and Control System
  - Secondary surveillance radars
    - which rely on : Airport transponders and surface-movement radars

AIP - Excursion

Volkswagen

Zuzanna Haladova

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Volkswagen

FISeQs (FertigungsInformations und Steurungsystem)

- To assure the quality of the production
- To find defects as soon as possible
- To define control points in the system
- To process electronic results
- To provide interface between system and human control

Zuzanna Haladova

Volkswagen

FISeQs system is running on two types of hardware :

- eQs stations
  - > Industrial computer
  - > Tactile screen
  - > Barcode reader Datalogic M200
  - > MFP reader Interflex

- HDT (Handhelds) CASIO DT-X10M30E
  - > Tactile screen
  - > Integrated barcode reader

Volkswagen

How does it work ?

Customer → Barcode on the Coachwork

↓

Production Hall → Control

↓

Final Control → Repair Station

↓

DISTRIBUTION

Volkswagen

Control Systems in the Production Halls :

- Human Inspection
  - Human Inspectors are controlling the correctness of production
- Laser Control
  - Consists of laser stations Perceptron which controls the accuracy of the coachwork by measuring the laser reflection

Thank you for your attention !

Questions ?

Presentation organized and designed
by Fatih Ugur

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