ENERMETER

Seeing in first

who we are

a successful history

Who we are

ENERMETER is a technological based company working in the development of innovative solutions on METERING and COMPUTER VISION

- Started in 2001.
- Based in Braga, north of Portugal.
- It offers highly trained professionals with large experience, aiming to answer to any challenge.
- Total number of collaborators: 26
  - 23 PhD/MSc/BSc, multidisciplinary group

COMPUTER VISION DIVISION

ENERMETER MEDICAL IMAGING

COMPUTER VISION ACADEMY

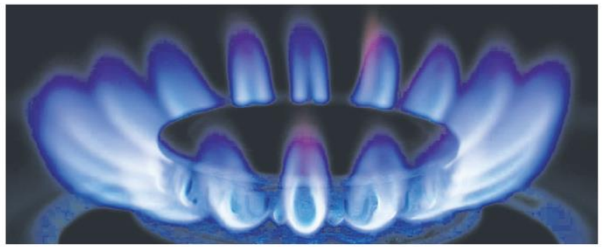
Industrial Imaging

Medical Imaging

Academic skills

METERING DIVISION

ENERMETER develops and commercializes systems and services for metering, control and management of energy and fluids.



NOT THE FOCUS OF OUR PRESENTATION

COMPUTER VISION DIVISION

ENERMETER creates and develops systems based on image processing and analysis techniques that can be used in inspection of raw-material, components and processes.

ENERMETER MEDICAL IMAGING

COMPUTER VISION ACADEMY

Industrial Imaging

ENERMETER's automatic inspection systems put together hardware and software (developed by ENERMETER team) based on the state-of-the-art artificial vision technology.

These automatic inspection systems, designed specifically for each customer, can be implemented in any production line point, saving time and space on the customer side

COMPUTER VISION DIVISION

ENERMETER creates and develops solutions based on image processing and analysis and artificial intelligence algorithms that can be used in helping diagnosis.

ENERMETER MEDICAL IMAGING

COMPUTER VISION ACADEMY

Medical Imaging

ENERMETER has been developing several projects in medical imaging, such as:

- computerized system for classification of micro-calcifications present in mammography;
- system for Diagnostic and monitoring of Diabetic Retinopathy;

and

- analysis of musculoskeletal ultrasound image.

COMPUTER VISION DIVISION

The Academy's mission is to generate smart investment opportunities, particularly in research and innovation in the field of computer vision.

ENERMETER MEDICAL IMAGING

COMPUTER VISION ACADEMY

Academic skills

Synergies between the ACADEMIC scientific knowledge and the COMPANIES' technical knowledge.

CVA aims to promote sustainable growth of the computer vision area through new players capable of responding to increasingly demanding challenges, creating a solid bridge between the university and the enterprises.

Who we are

COMPUTER VISION ACADEMY

Horas	Dia 1	Dia 2	Dia 3	Dia 4	Dia 5
08H30	CV	CV	CV	CV	CV
09H00					
09H30					
10H00					
10H30	Intervalo	Intervalo	Intervalo	Intervalo	Intervalo
11H00	CV	CV	CV	CV	CV
11H30					
12H00					
12H30					
13H00	Almoço	Almoço	Almoço	Almoço	Almoço
13H30					
14H00	Abertura Oficial	CEI Apresentação - Casos - Debate	STRONGSTEP Gestão de Requisitos - Debate	UNICER Apresentação - Casos - Debate	AMORIM Apresentação - Casos - Debate
14H30					
15H00	BOSCH Apresentação - Casos - Debate				
15H30					
16H00		Intervalo		Intervalo	Intervalo
16H30		INFAIMON Apresentação SW	Atividade Social e Jantar	ENERMETER Apresentação - Casos	ENERMETER Apresentação - Casos
17H00	Intervalo				
17H30	INFAIMON HW				Encerramento
18H00					

Who knows us

As a result of ENERMETER's work, capacity and innovative character, the company has increasingly assumed itself as a global leader in the development of innovative solutions in metering and artificial vision.

Computer Vision - Some Projects

- ESOBASIS - ENERMETER System Of BAckStitch InSpection

- ESOTIREINSP - ENERMETER System Of Tire Marks Inspection

- ESOVYM – ENERMETER System Of VineYard Monitoring

- MICABCAD - Microcalcification Computer-Aided Detection

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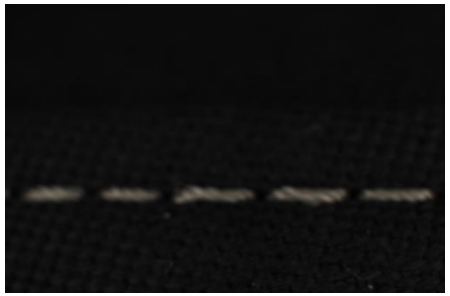
ESOBASIS

ENERMETER System Of BAckStitch InSpection

faurecia

A system for Backstitch Inspection

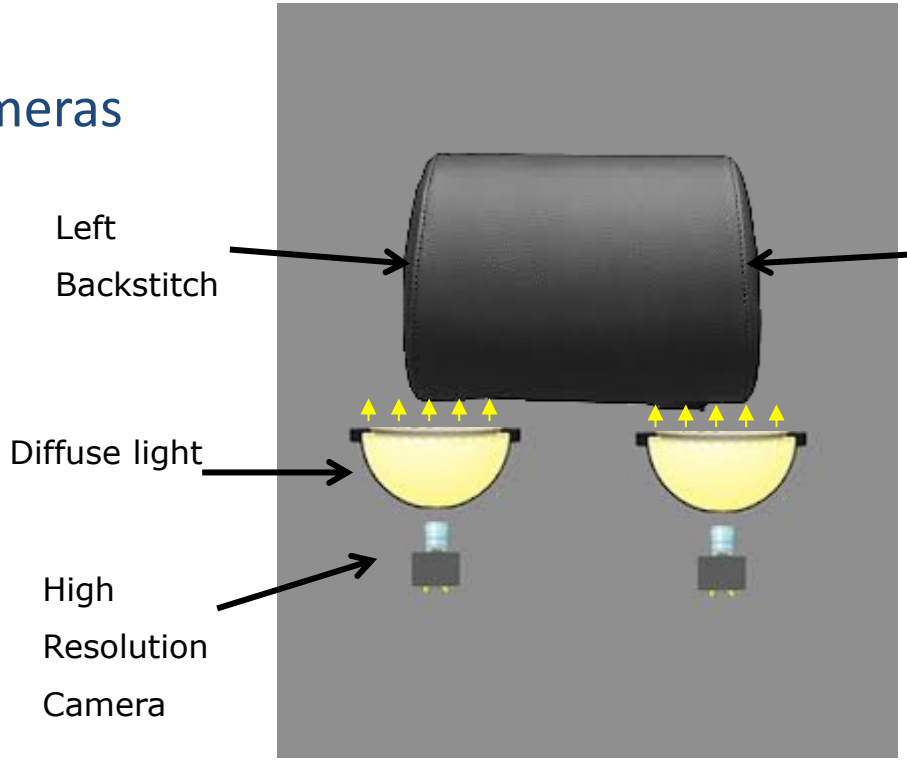
- Colour Defects in Backstitch of Headboard Car Seats
- Problem
  - Wrong Colours
  - Tinny Colour Differences
  - Tinny Gray Differences



Computer vision architecture

- Industrial Computer
- 2 High Resolution Cameras
- Diffuse illumination

One for each side of the headboard car seat



Computer vision architecture

- Industrial Computer
- 2 High Resolution Cameras
  - Spatial: 2452 X 2056
  - Depth: 16 bits
- Diffuse illumination

- Increase the range of tons from 256 to 65536
  - Higher sensibility to minor variations
- From the 16 bits given by the camera remove the 2 less significant
  - Noisy bits
  - 14 bits depth – 16384 tons values per channel

Inspection Algorithm

1. Backstitch Acquisition
   - 10 images with different shutter – from dark to bright
2. Backstitch region detection using the image with the middle shutter value
3. For each image, within the Backstitch blob, apply:
   - Morphological filter to remove the Backstitch texture
4. For each image, within the Backstitch blob, extract color signature
   - Histogram of HCL and CIE Lab component
5. Bayesian classifier using the color signature as feature vector

ESOBASIS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- The winner strategy
  - High resolution cameras
  - High depth of the pixel
  - Color signature based on 10 images of different shutter values
  - Bayesian classifier

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ESOTIREINSP

ENERMETER System Of Tire Marks Inspection

- Two types of marks:
  - Sidewall marks
  - Tread Stripes

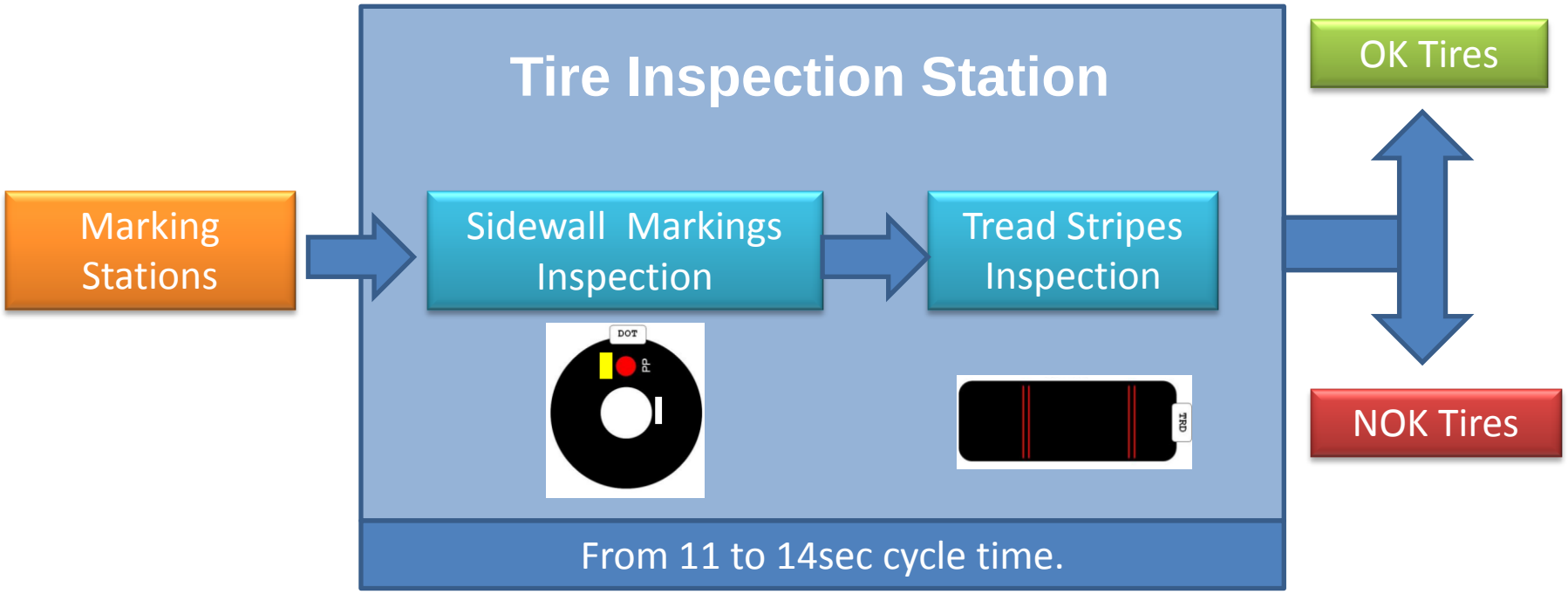
- A system for mark detection and measuring in tires
  - **Tires needs to be marked according to specific radius and angular position, to define the critical points of the tire. This insures better performance on the road** and also less wear/waste when the tire is correctly mounted in the rim.
  - Human classification/measuring is highly subjective and time consuming
    - **The precision required makes human classification/measuring almost impossible**
    - **We most quantify the angle and radial position of the marks**

Sidewall Markings

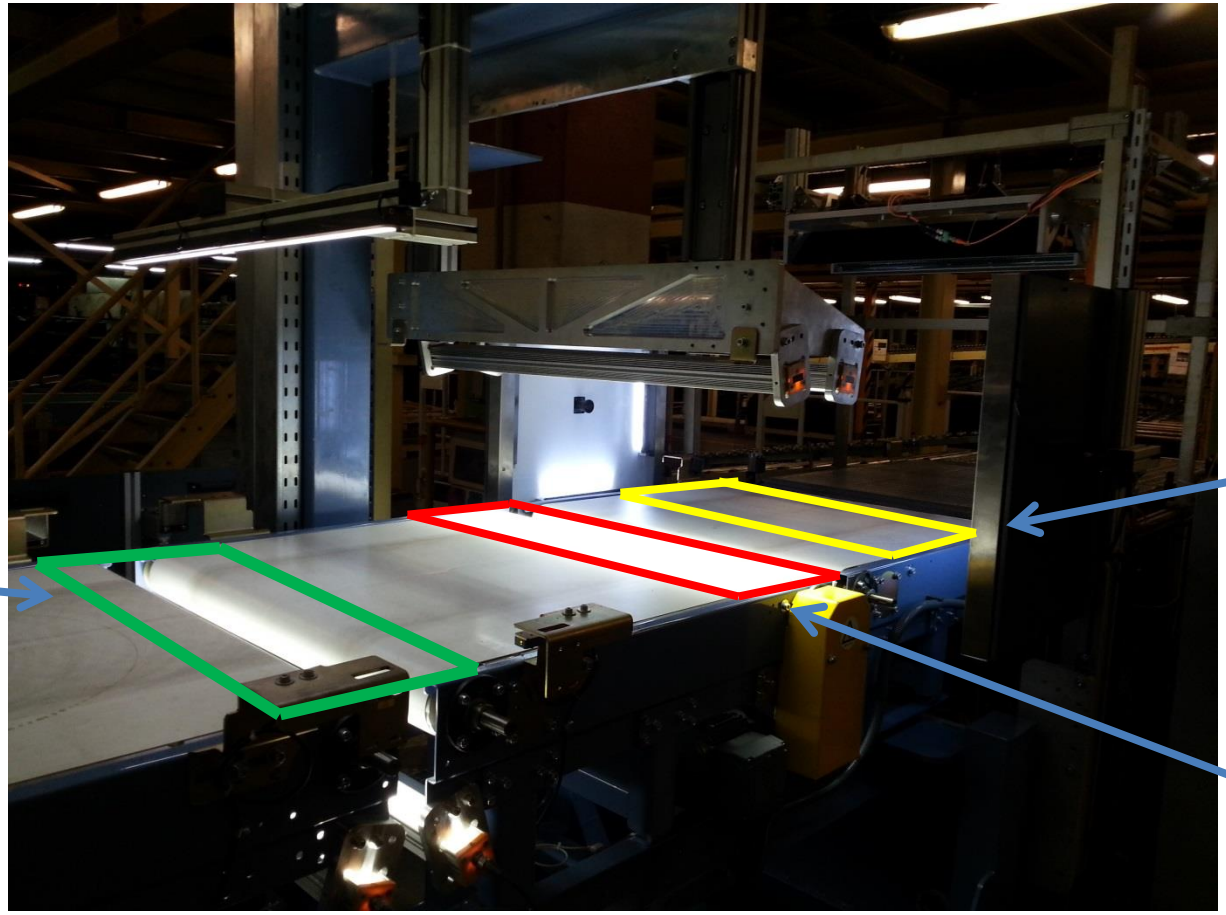
DENOMINATION	TECHNOLOY	GEOMETRY	COLOR	VISUAL	REMAKRS
Dot D10 robust	LTA	OD 10mm	Red		POMS-spec!
	LTA	OD 10mm	White		POMS-spec!
	LTA	OD 10mm	Yellow		POMS-spec!
Donut D12 Robust	LTA	OD 12,5mm	Red		POMS-spec!
Dot D14 Non-permanent	LTA	OD 14mm	Orange-red		POMS-spec!
RHHP-Label (spec. color)	RHHP	35x17mm	Magenta		Color-spec: GM Korea!
	RHHP	35x17mm	Yellow		Color spec: Nissan NA
Force Correction	Ink-Jet	Height 12mm	White	BCD	Width 0,5mm
Conicity-Letter	Ink-Jet	Height 12mm	White	NN	Letters chosen based on Conicity-Grade: NN, N, P or PP
Conicity Stripes on Tread	Airbrush	Width 6-15mm (readable from a distance of 3m under normal light conditions)	Sorting: DUAL >> White	N: | P: ||	Applied on tread. 2x, 180° on circumference. Length: 2/3 or tread with.
		Width: 6-15mm (readable from a distance of 3m under normal light conditions)	Sorting: QUAD - narrow limit: green - upper limit: red	Negative: | Positive: || - - - Negative:| Positive: ||	NN – N – P – PP | - | - || - ||

Tread Stripes

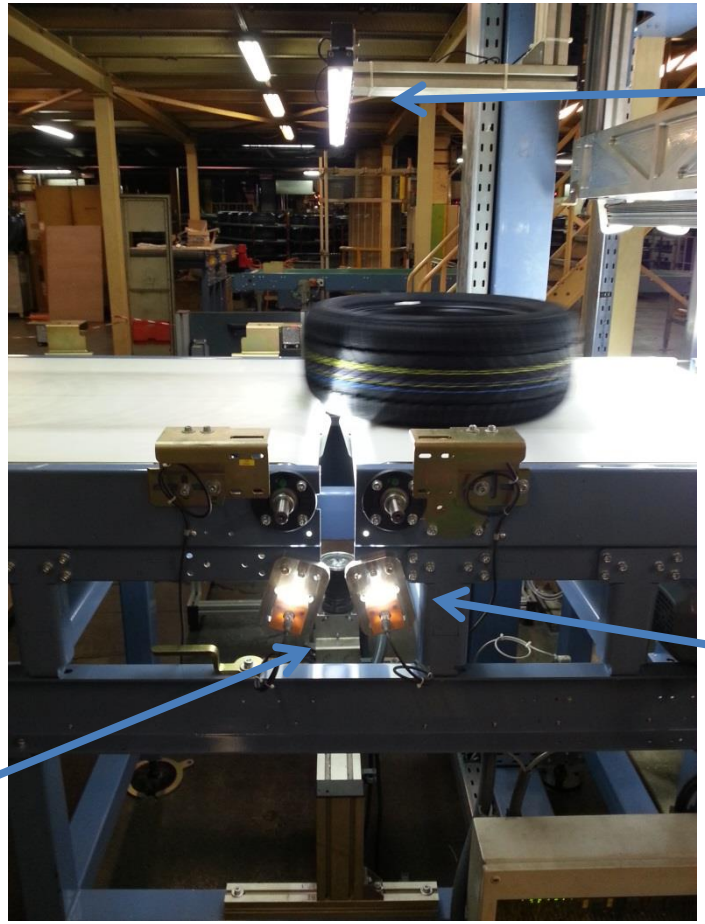
Inspection System in the Line



Inspection Station – Areas of Inspection



Bottom Camera



Acquisition System – Sidewall Images

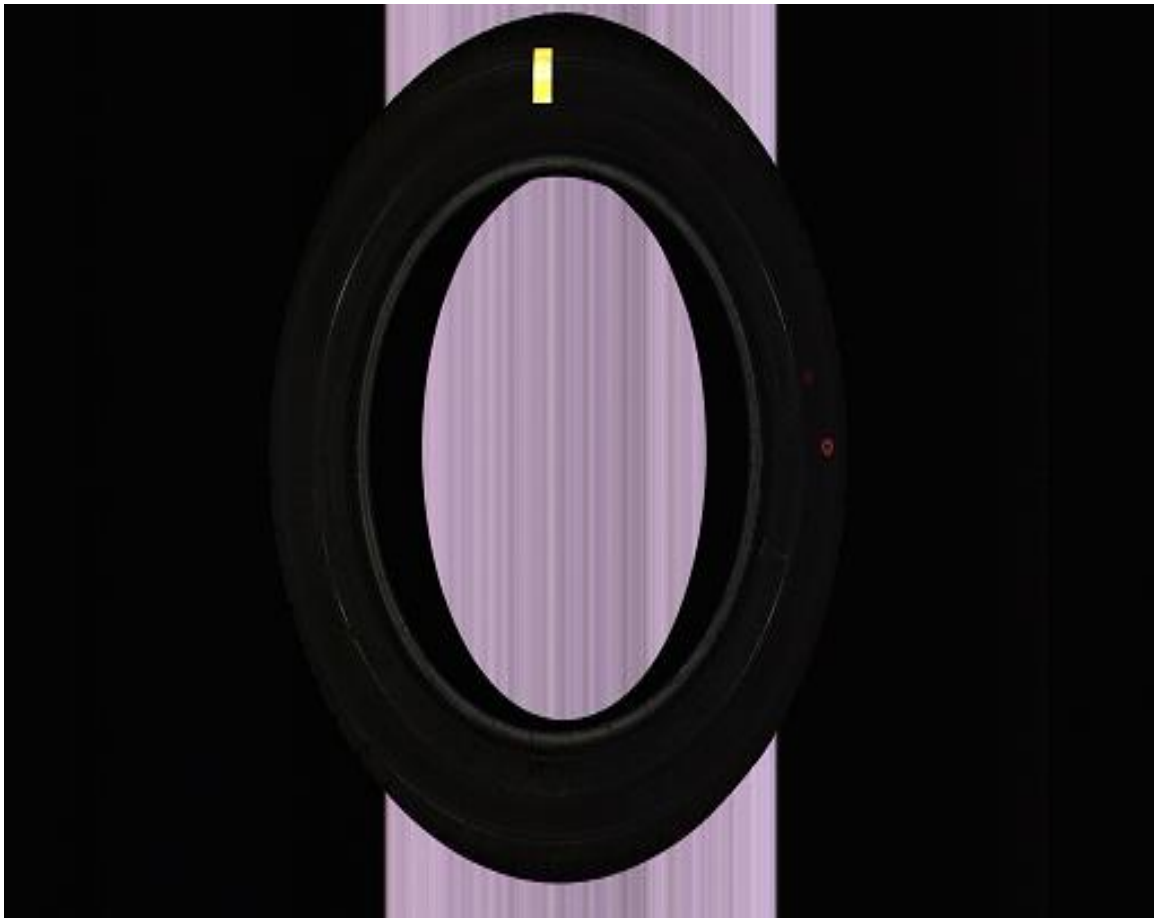
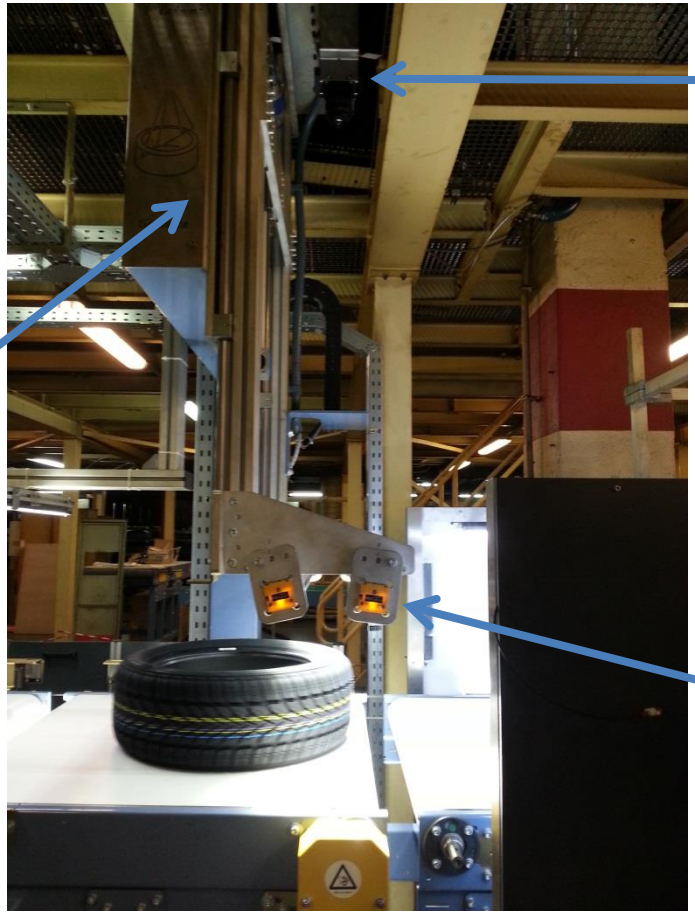


Image Size 196MB

Top Camera



Linear Camera

Vertical axis to ajust camera position

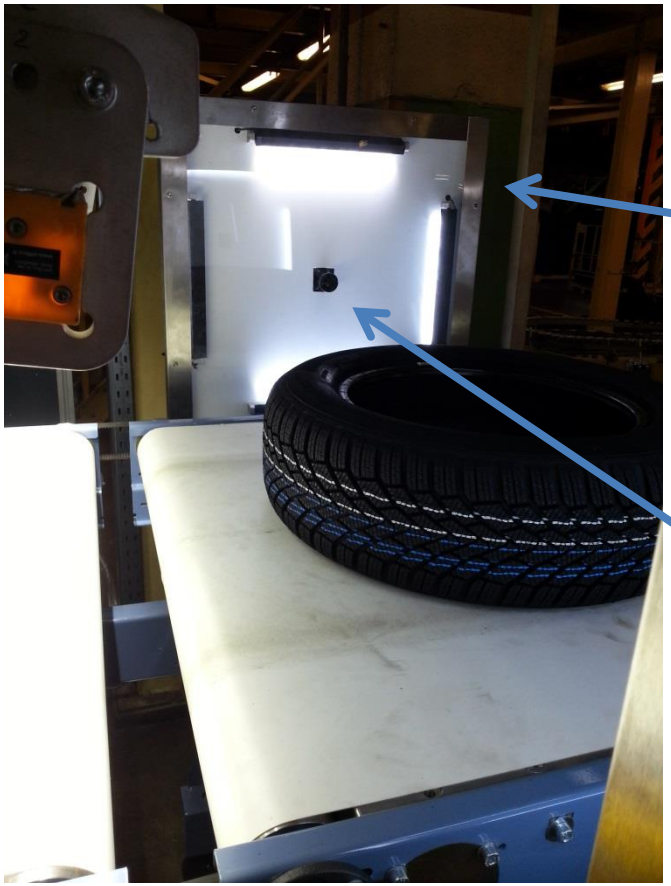
Two led bars illuminators

Acquisition System – Sidewall Images

Image Size 196MB

Acquisition System - Tread

Left Tread Camera



Tread illuminators

2D Color Cameras

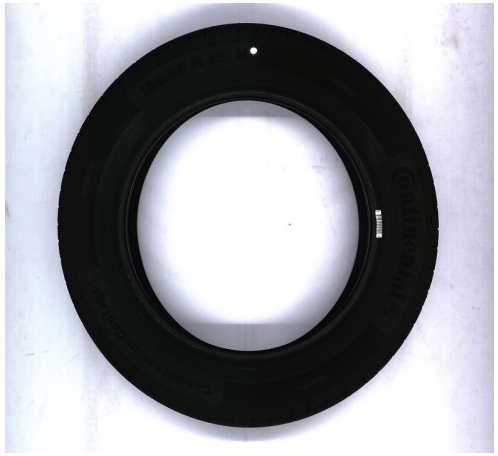
Right Tread Camera

Acquisition System - Tread

- At this stage the tire stops for the 2 side cameras acquire the tread of the tire.

Acquisition System – Sidewall Image Calibration Procedure

- The images acquired have artifacts that needs to be removed, namely:
  - Unbalanced white color
  - Image distortion
  - Width and Height are not proportional
  - Orientation of the Top Camera might be different from the Bottom Camera



- To correct the images we use 3 different calibrators patterns
  - **1** – Used to do the white balance of the cameras.
  - **2** – Used to remove horizontal (image plane) distortion.
  - **3** – Used to remove vertical (image plane) distortion and align Top and Bottom Cameras.

Acquisition System – Sidewall Inspection Algorithm

1. Tire center detection
2. Barcode detection
3. Letters detection
4. Dot and Donut detection
5. RHHP-Label detection

Marks detection in both cameras

6. Merge information from both cameras
7. Tire measured and data sent to central controller

Acquisition System – Tread Inspection Algorithm

1. Tire center detection along with information (rim diameter, tread size…) sent from central controller – for adjusting ROIs
2. Stripes detection
3. Post-processing for stripes position improvement
4. Stripes size and position calculation
5. Tire measured and data sent to central controller

- The winner strategy
  - Acquisition setup
    - High resolution linear cameras vs Matrix cameras
    - High definition linear illumination
  - Calibration strategy
    - Color balance
    - Distortion removal
  - Leading to simple algorithms

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ENERMETER System Of VineYard Monitoring

ESOVYM

❑ Remote Detection

items	Satellite	Aircraft – Manned	Aircraft – Unmanned
Image Resolution	Low resolution (1 - 40 m / pixel)	Spatial resolution – 50 cm	Spatial resolution – 5 cm
Weather condition	It depends on the weather condition	Meteorology (not operating) - Low clouds	Meteorology (not operating) - Rain and fog
Cost	high cost	Operating Cost - Average cost	Operating cost - Low cost
Coverage area	Ideal for large coverage areas	Use - Medium installments > 30 ha	Use - Small portions < 30 ha
others	Image data dependent of the satellite route	Attention must be paid to the influence of the thermal flow from the acquisition of IR image	- With the appearance of low cost drones some Unmanned Aircrafts are now used - Thermal flow from the acquisition of IR image

- Remote Detection – present limitations
  - information that is delivered to the vineyard manager is limited to the canopy, which can be confused with soil;
  - indicators obtained by aerial images may not reflect the true state of the vineyard, in situations of very dense or sparse density of leaf area

ESOVYM

- Remote Detection – present limitations
  - indexes may suggest the existence of stress on the vine, but using only the aerial image is not possible to identify which type of stress; it is necessary to go to vineyards for further analysis
  - from currently used indicators it is difficult to infer other factors such as size of the vegetative hedge, leaf area, number and density of grapevines

- Remote Detection – present limitations
  - finally, another important factor is related to operation cost and logistics of current systems. These two aspects lead to collect aerial information mainly only on véraison stage, leaving outside the flowering and maturation stages

ESOVYM

- Remote Detection
  - ESOVYM – what we want
    - **Spatial resolution <2 cm**
    - **Image acquisition of all vegetative hedge**
    - **Cost of operation - operation during other jobs**
    - Use - Portable system and without supervision by operator
    - **Extract a new set of indicators**, such as
      - Leaf area index
      - Hedge size index vegetative
      - Leaf area ratio (m2 / ha) for grape production (kg)

ESOVYM

ENERMETER SYSTEM OF VINEYARD MONITORING

The overall goal of the project was the development of a mobile unit for acquisition and processing of vineyards images with high resolution and detail

In the validation process of the results, we obtained the cooperation of Sogrape. Which it gave access to their farms in Anadia; Barcelos and Douro

SOGRAPE VINHOS

ESOVYM

- Specific Goals
  - During displacement, the unit performs simultaneously the acquisition of images (in the visible and infrared spectrum) of left and right trellis for processing, analysis and visualization.
  - Acquisition of 100% of the target area of the vineyard and of entire vines' canopies, generating high resolution maps of the whole leaf surface without need for expertise in navigation or software.

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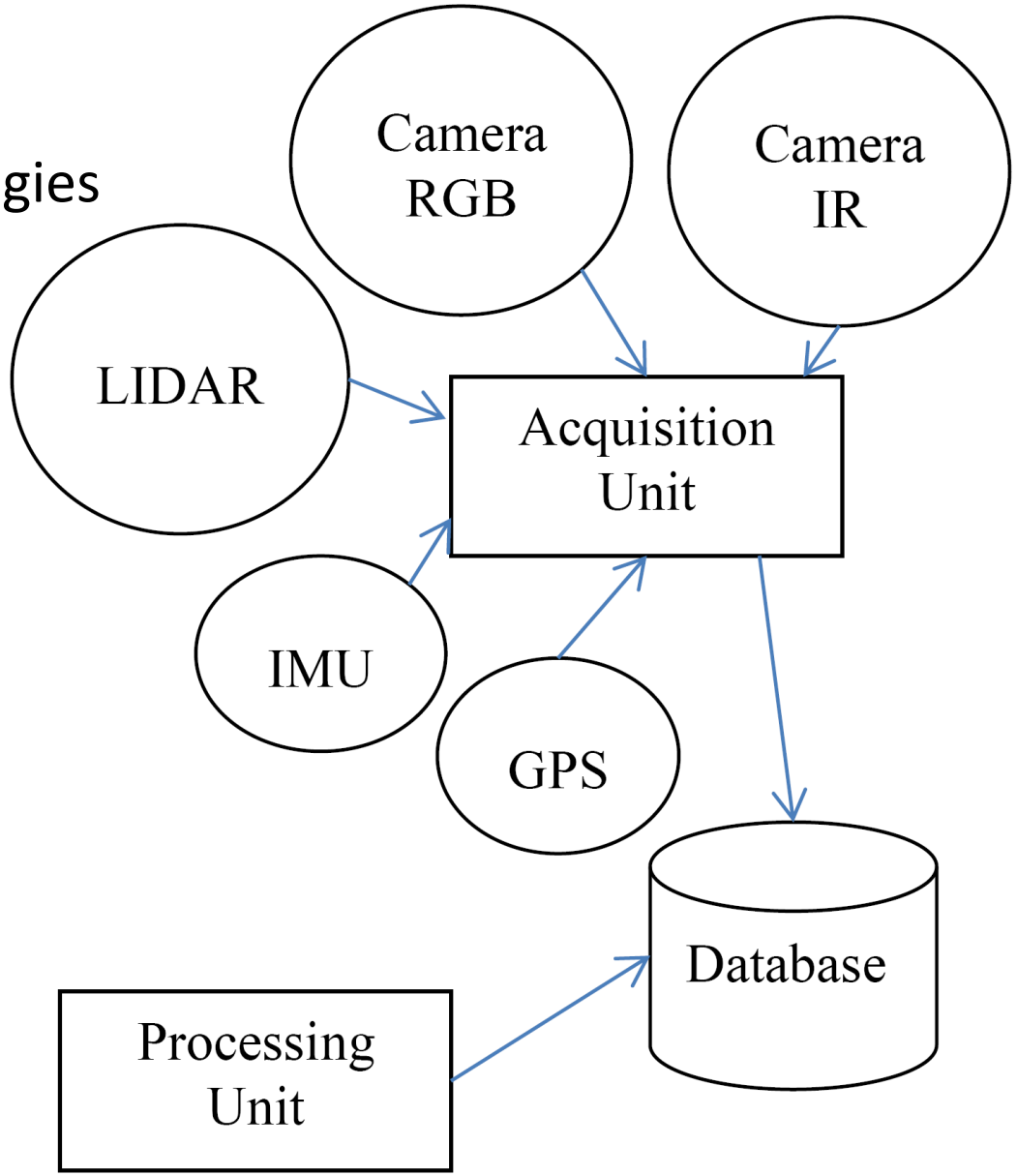
- Technologies



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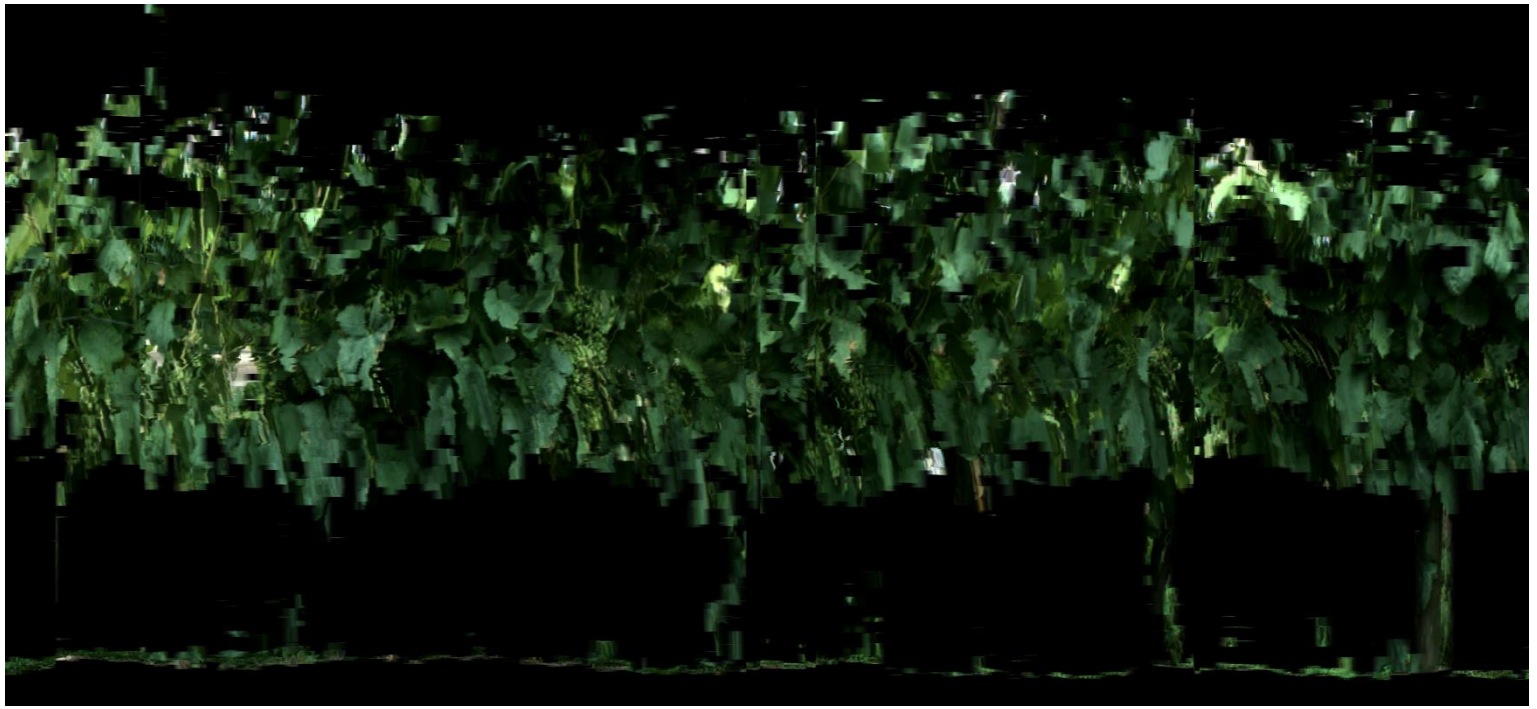

ESOVYM

- Functionalities - After **automatic** processing and image analysis procedures
  - The system **creates geo-referenced maps** with traditional indicators, such as NDVI (Normalized Difference Vegetation Index)
    - **Besides these traditional** indicators a set of others can be obtained
  - The operator can

multiresolution analysis and display

- Navigate through geo-referenced maps
- Navigate through the panoramic images of the trellis
- Navigate through the set of all images acquired – raw data

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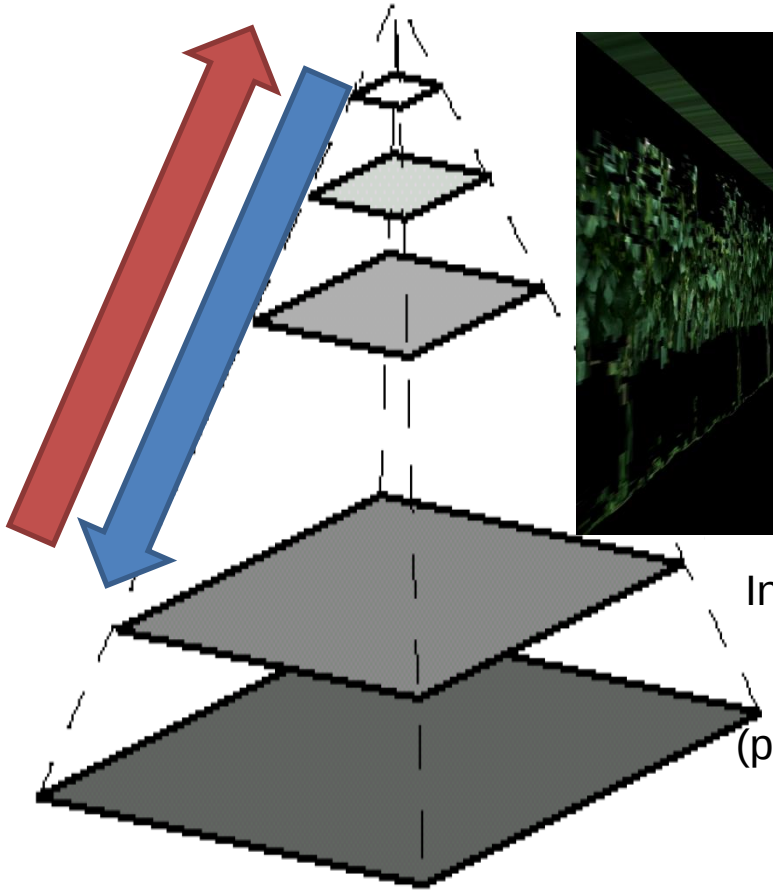
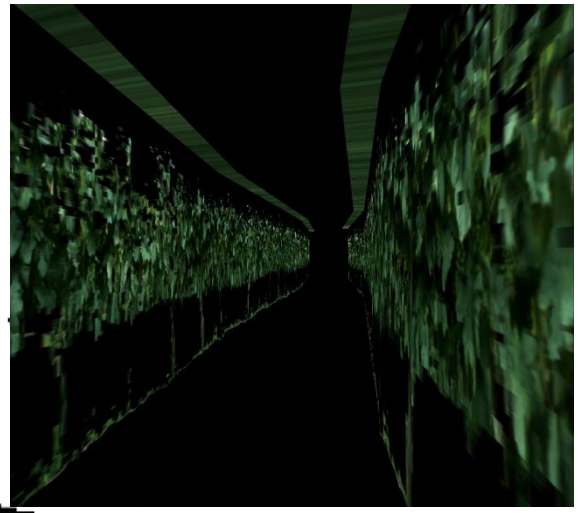
High level information (high degree of abstraction)





Intermediate level information (panoramic image)

More detailed information (lower degree of abstraction)

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ENERMETER SYSTEM OF VINEYARD MONITORING

Data acquisition Hardware

Data production module

- Trajectory construction (GPS + IMU)
- Point Cloud generation (LIDAR)
- Image pre-processing (Camera)

Post-processing module

- Point Cloud adjustment
- Panoramic generation

Maps generation module

- Points of interest classification
- Maps generation and reports

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- ESOVYM – actual indicators extracted
  - Photosynthetic Vigour Ratio - G/R;
  - Plant Pigment Ratio - G/B;
  - Plant Cell Density - IR/R;
  - Excessive Green Index - (2*G-R-B);
  - Normalized Difference Vegetation Index - (IR-R)/(IR+R);
  - **Leaf area index**

ESOVYM

Photosynthetic Vigour Ratio index

Plant Pigment Ratio index

Leaf area index

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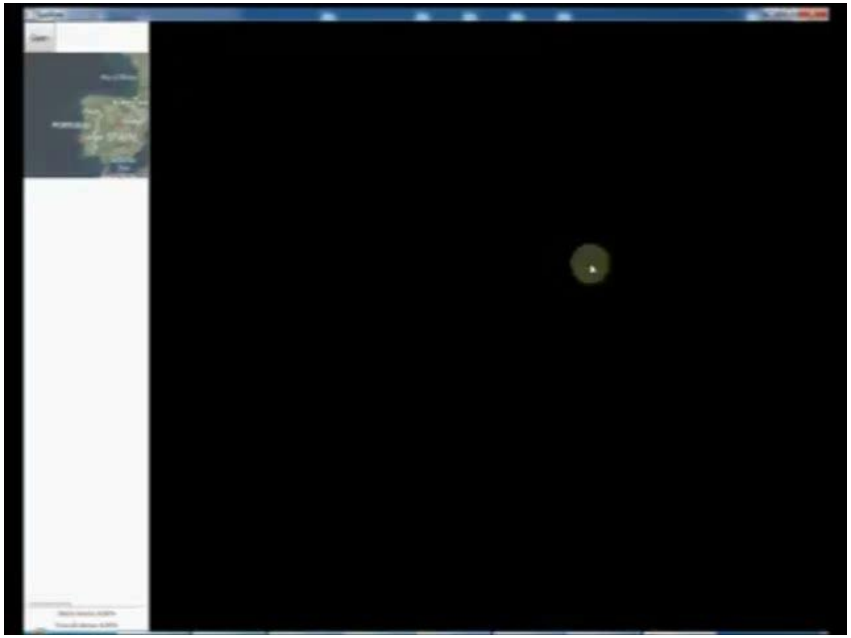

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MONITORING

❑ Conclusions / General Features

- ❑ Robust and maintenance-free
- ❑ Flexible for different applications – using agricultural tractor
- ❑ Low operating cost – can be done at the same time of other operations
- ❑ Portable and without the need for operator supervision

ENERMETER MEDICAL IMAGING

MICABCAD

Microcalcification Computer-Aided Detection

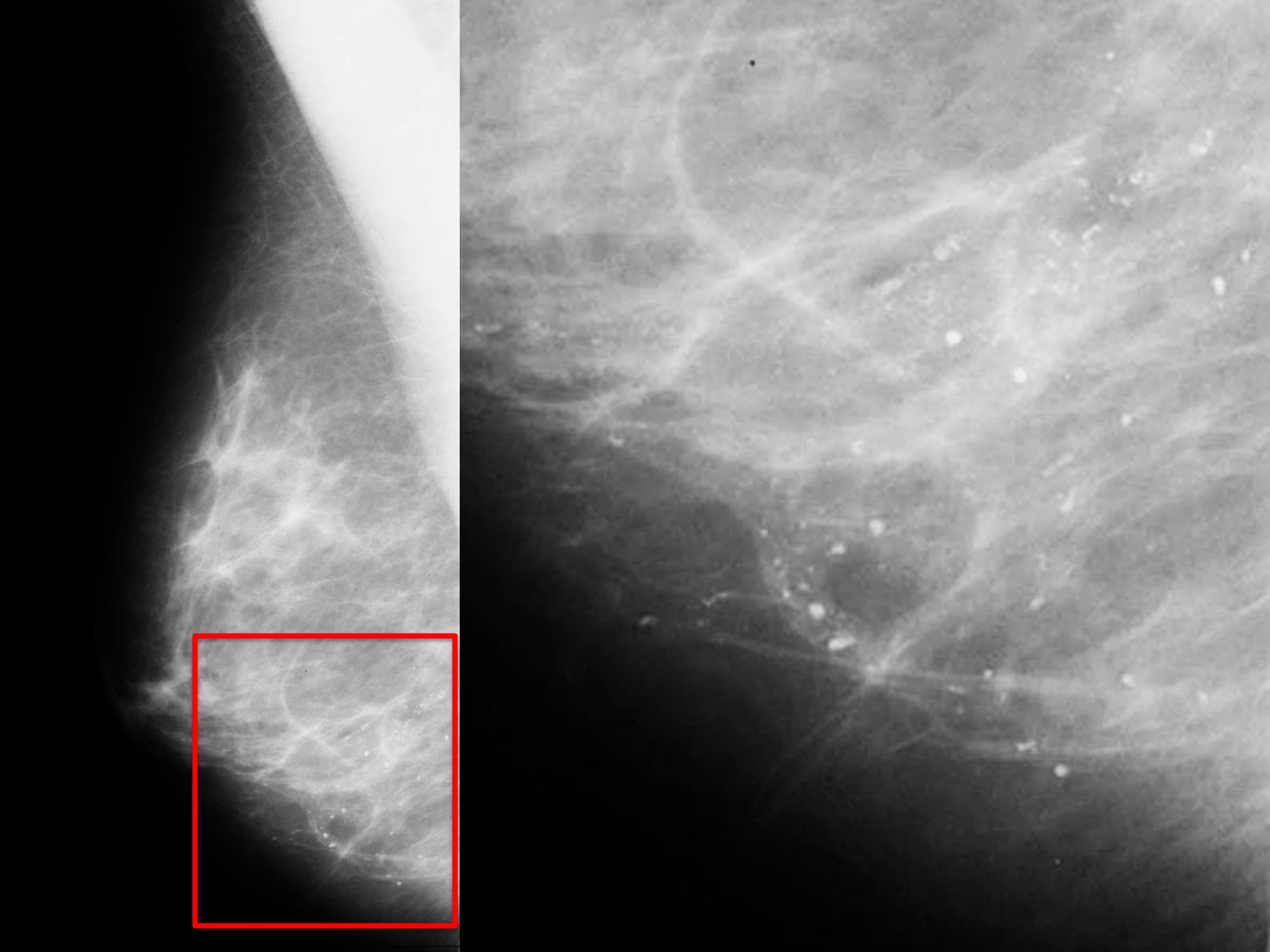
MICABCAD

- **Detection of microcalcifications in direct digital mommography**
  - Main Technical Objectives
    - **Micro-calcification enhancement and detection;**
    - **Clusters identification and malignancy prediction**

Dr. Campos Costa Desde 1943 IMAGIOLOGIACLÍNICA

Centro de Computação Gráfica

Universidade do Minho



Centro de Computação Gráfica

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EMPRESA CERTIFICADA apcer ISO 9001 · CERTIFIED IQNet MANAGEMENT SYSTEM · PME excelência'14 · CMMI DEV /2 SM
Exp. 2018-06-12 / Appraisal #24559

A ENERMETER preocupa-se com a sustentabilidade e proteção ambiental. Todos os suportes de comunicação, marketing e economato são impressos em papel fabricado com matéria-prima natural e renovável, 100% reciclável e produzido com tecnologias limpas.

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