



ENERMETER

Seeing in first

RHEUMUS

Ciclo de Palestras Imagem Médica 2014

Sistemas Interactivos para a Saúde

(Mest. Inf. Médica)

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 employees: > 20
 - ❑ 2 PhD; 2 PhD Student; 9 MSc; 5 BSc, multidisciplinary group

Who we are

METERING DIVISION

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

NOT THE FOCUS
OF OUR
PRESENTATION



The available solutions start in the simple basic meter to the most complex integrated systems of metering, control, communication and management of consumption data.

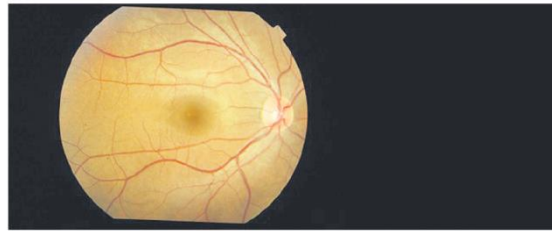
The systems developed by ENERMETER allow the performance increase of the distribution networks and the real time reading, in order to optimize the use of the natural and human resources.

Who we are

COMPUTER VISION / ARTIFICIAL VISION DIVISION



Industrial Imaging



Medical Imaging



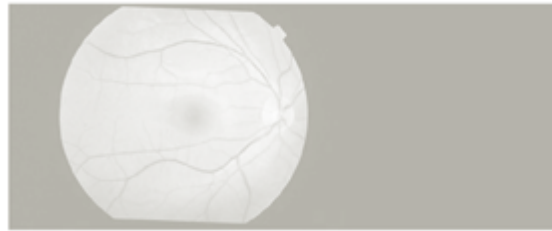
**COMPUTER VISION
ACADEMY**

Academic skills

Who we are

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.



COMPUTER VISION
ACADEMY

Industrial Imaging

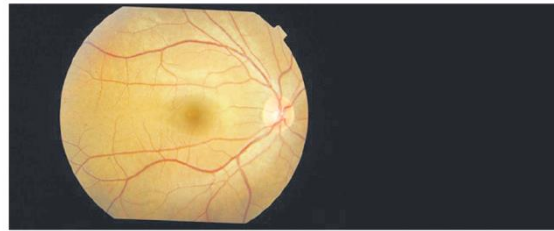
ENERMETER's automatic inspection systems put together hardware and software (developed by ENERMETER team) based on the state-of-the-art artificial vision technology.

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

Who we are

COMPUTER VISION DIVISION

ENERMETER creates and develops systems based on image processing and analysis techniques that can be used in medical imaging.



COMPUTER VISION
ACADEMY

Medical Imaging

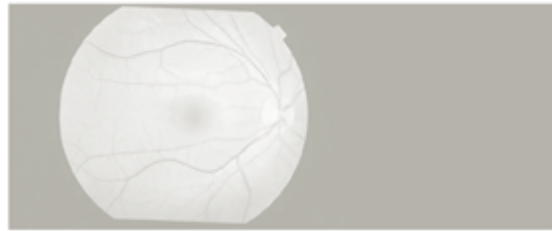
ENERMETER has been developing several projects in medical imaging, such as:

- computerized system for classification of micro-calcifications present in mammography;
 - system for Diagnostic and monitoring of Diabetic Retinopathy;
- and
- analysis of rheumatology ultrasound image.

Who we are

COMPUTER VISION DIVISION

CVA aims to promote sustainable growth of the computer vision area through new players capable of responding to increasingly demanding challenges.



**COMPUTER VISION
ACADEMY**

Academic skills

The Academy's mission is to generate smart investment opportunities, particularly in research and innovation in the field of computer vision through synergies between the ACADEMIC scientific knowledge and the COMPANIES' technical knowledge.

❑ Main competences

❑ Systems specification

❑ CCDs; optics, illumination and overall setup

❑ Image processing and Image analysis

❑ Image calibration, blob analysis, color and texture segmentation, image registration, ...

❑ Machine learning/artificial intelligence

❑ Neural networks, fuzzy inference systems, MAS

Artificial Vision



DEVELOPED SOLUTIONS

AUTOMOTIVE INDUSTRY

Inspection of car radios and navigation units

Logos detection and insertion guidance

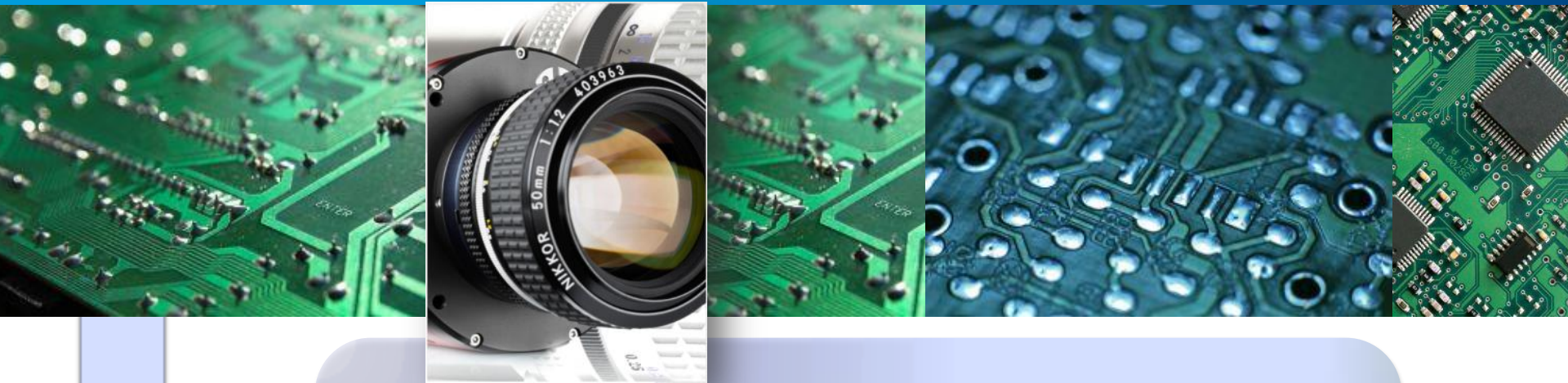
Inspection of tire marks

Inspection of injection molded parts

Inspection of casting metal parts

Automatic enrollment identification of containers

Artificial Vision



DEVELOPED SOLUTIONS

ELECTRONIC INDUSTRY

Measure of electronic PCB's components pins

Detecting and verifying PCB's components color and polarity

Inspection of displays (i.e. dead pixels and segments; color control)

Inspection of soldering of electronic components

Artificial Vision



DEVELOPED SOLUTIONS

PLASTICS INDUSTRY

Inspection of plastic parts (shape, size and color evaluation)

Stamping anomalies and impurities detection

Detection of defects, counting and separation of preforms

Artificial Vision



DEVELOPED SOLUTIONS

AGROFOOD INDUSTRY

Dimensional fruit calibrator

Selection of fruits by their color

Correct packaging inspection

Inspection of plastic trays

Inspection of beer crates

Leaks and micro-leakes detection in beverage barrels

Artificial Vision



DEVELOPED SOLUTIONS

TEXTILE INDUSTRY

Metering and control system for fabric's width

Colour drift detection

PAPER INDUSTRY

Detecting a stack packs swapped

Artificial Vision



DEVELOPED SOLUTIONS

MEDICAL IMAGING – 3 ongoing projects

Detection of micro-calcifications in digital mammography direct

Temporal evolution of diabetic retinopathy in fundus images

A system for the analysis of ultrasound images for rheumatology

Who we are – brief resume

Specialists in artificial vision solutions in the market since 2001. **SME leader for 5 consecutive years and SME excellence in 2013.** With ISO 9001:2008 certification and with **IT-Mark label**

Was the first Portuguese company to export automatic systems (**machine vision**) for inspection and quality control in the German automotive industry

100% Portuguese company specialized in Machine Vision Software

Recognized by the technical merit and innovation ability, evidenced by high standards, quality and rigor of world-known companies

ENERMETER is a member of **PRODUTECH** - Pole of Manufacturing Technologies - in the field of Suppliers of Technology

ENERMETER is a member of **COTEC Portugal** - Associação Empresarial para a Inovação

Who we are – brief resume



COMPUTER VISION ACADEMY



ENERMETER



DOCTORAL PROGRAM
IN COMPUTER SCIENCE

MAI
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Second Course on Advanced Techniques of Image Processing and Analysis

Was the first Portuguese company to export automatic systems (**machine vision**) for inspection and quality control in the German automotive industry

A pioneer in creating the **Computer Vision Academy**. With the spirit of creating a **solid bridge** between the academy and the enterprises, in order to put in the market a course of advanced techniques of image processing and analysis, **with a label of merit and excellence**.

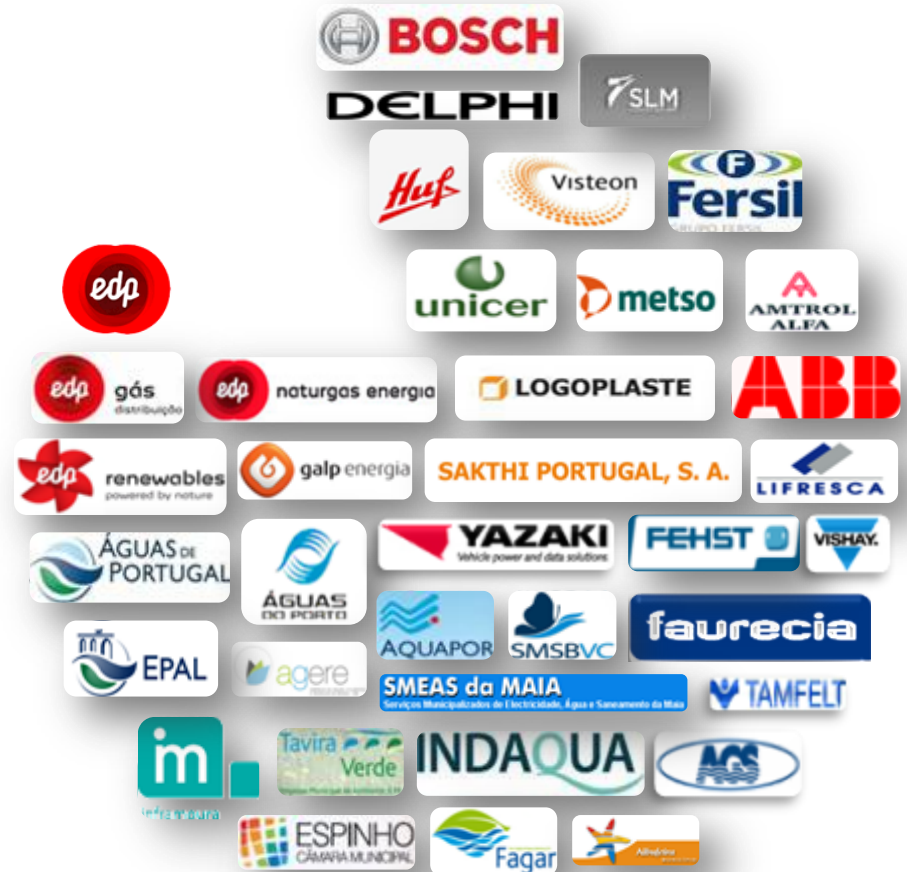
Who knows us

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.

Portugal | Spain | Germany | Angola | Malaysia | China

Competitive Advantages

Innovation Technology
Experience Knowledge
Research & Development





ENERMETER

Seeing in first

RHEUMUS

**A system for the analysis of
ultrasound images for rheumatology**

Rheumatic diseases

- Painful conditions usually caused by inflammation, swelling, and pain in the joints or muscles
- Considered as a social, economical and public health problem since they are the leading cause of disability and pain, mainly in the developed countries
- Early diagnosis is very important for an adequate treatment and to avoid severe disability
- There is a need to implement preventive actions to help early diagnosis, such as the use of new diagnostic devices and treatments

Epidemiology

In Portugal, the prevalence is between 16% and 24%, affecting more the women and increasing with age.

The first cause of temporary disability

Represent the 2nd or 3rd of the costs of drug consumption

Represent 16 to 23% of the general practice consultations

Responsible for 30% of the reduced mobility, 40 to 60% of the long disability situations, 43% of days of absence from work due to illness.

Responsible for 35 to 41% of the number of early retirement due to illness.

Rheumatoid arthritis

- Rheumatoid arthritis is a chronic inflammatory disease characterized by the development of **synovitis**, which damages cartilage, bone, ligaments and tendons.
- Erosions of bone and destruction of cartilage, occur rapidly and may be seen within the first 6 months of the disease, but continue to develop over time.
- The joints involved most frequently are the proximal interphalangeal (PIP) and metacarpophalangeal (MCP) joints of the hands, the wrists, and small joints of the feet including the metatarsophalangeal (MTP) joints. The shoulders, elbows, knees, and ankles are also affected in many patients.
- Diagnosis:
 - Physical examination
 - Clinical data and laboratory parameters
 - Imaging techniques

Rheumatoid arthritis

10 months

5 years

12.5 years

21 years



Imaging techniques

➤ Radiographic

➤ Radiological findings early in the disease may show nothing other than soft tissue swelling. With progression of the disease, narrowing of the joint space is caused by loss of cartilage, and juxta-articular erosions appear, generally at the point of attachment of the synovium. In end-stage disease, large cystic erosions of bone may be seen.

➤ More recently the introduction of **ultrasound (US)** and **MRI imaging** has improved the sensitivity of detecting joint damage earlier in disease.

Imaging techniques

Joint damage only visible in
US imaging

Normal joint



Joint damage
visible in Rx
imaging

Deform
Functional disability

Advantages of US

Portability

Cost effective
(26 € versus
127.9 €)

Without
radiation

Non invasive

Available in
every point
of care

The main articular
components are well
seen

Early signs of several rheumatic diseases can be observed: synovitis, erosion, tendinopathy, enthesopathy, osteophyte, distended bursa, presence of abnormal structures in soft tissue, cartilage damage, and even vasculitis

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Disadvantages of US

Images are difficult to learn

Few rheumatologists have experience in this kind of images acquisition and interpretation

There is a strong dependence between the operator experience and an image correctly analyzed and acquired

Variability intra and inter operator, reducing this examination reproducibility and thus, its diffusion among rheumatology

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Goals

- Development of a system for the musculoskeletal ultrasound images processing and analysis
- Identify, segment and quantify anatomical and pathological structures of the musculoskeletal system of the hand and knee joints, based on computer vision technology
- Aid in the images interpretations and, therefore, in the diagnosis and follow-up of rheumatic diseases
- Increase the reproducibility inter and intra observer of the ultrasonographic examination

Goals

- Possible applications:
 - Educational training courses for rheumatologists
 - Diagnosis of rheumatic diseases
 - Monitoring disease and treatment of patients in clinical trials and in clinical practice

Ultrasound imaging

- Ultrasound

- Sound waves greater than 20,000 Hz
- High frequency ultrasound is used for the diagnosis and treatment of patients
- Pulse of sound is sent to the soft tissues
- The sound interacts with the tissues – reflection, attenuation, diffusion, refraction
- The sound interaction and propagation in the soft tissues depend on the tissue characteristics: quantity of water, density, presence of air and fat



Differentiate tissues and thus identify anatomic and pathological structures

Ultrasound imaging

- Technical considerations
 - The transducer is responsible for the generation of a US beam and the detection of returning echoes.
 - New generation transducers may reach very high frequencies (up to 20 MHz)

High frequency

- improved resolution
- depth of penetration loss
- higher frequency transducers for superficial uses

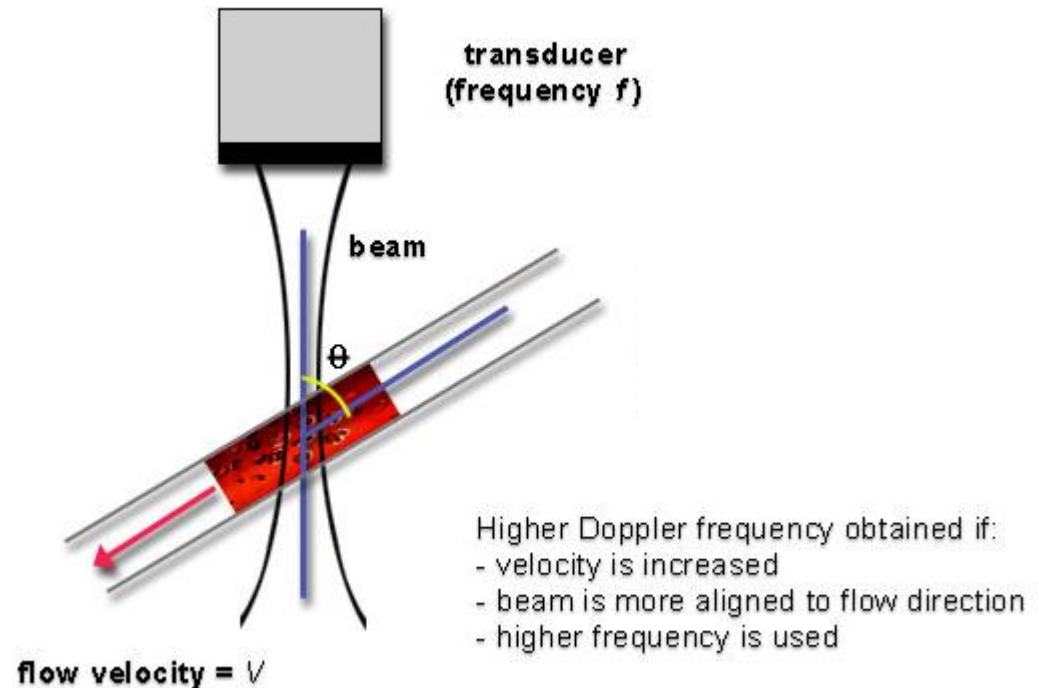
Low frequency

- poorer resolution
- full depth of penetration
- lower frequency transducers for general abdominal and pelvic uses



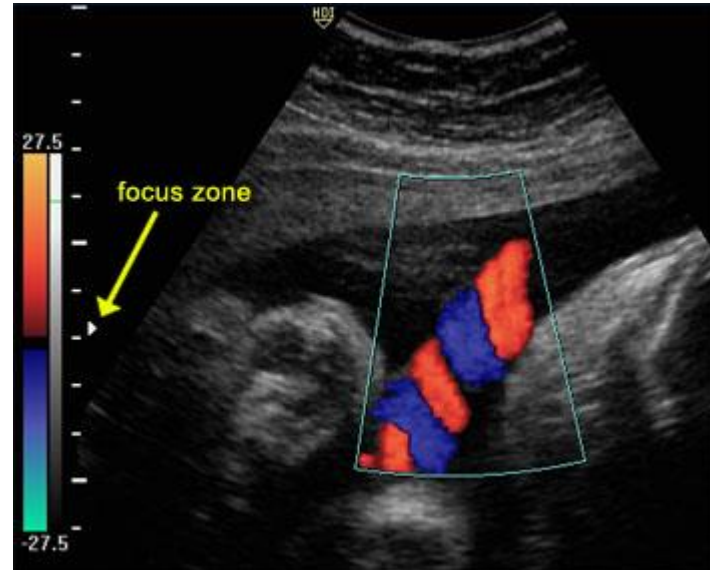
- Doppler effect

- Physical phenomenon in which the frequency of a wave that hits a moving body undergoes a variation that is directly related to the speed of the body itself
- The incoming wave has a higher frequency than the outgoing wave when the direction of the movement is towards the transducer while it has lower frequency when the direction of the movement is opposite



Ultrasound imaging

- Doppler effect
 - Evaluate blood flow
 - Screen for inflammation/vascularity
 - Monitor disease activity, and/or treatment response
 - Images can be scored on a semiquantitative scale from 0-3 for synovitis

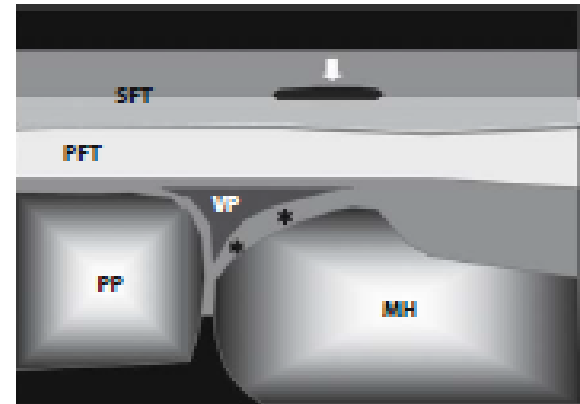
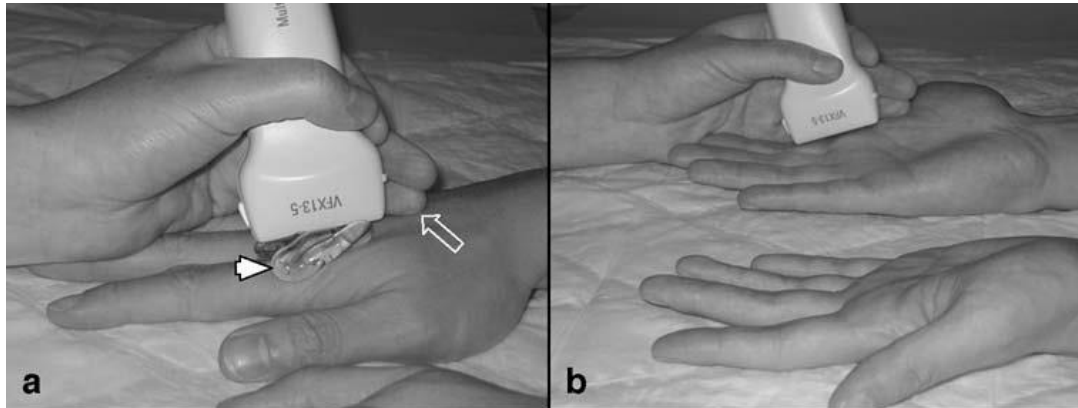


Red – flow toward the transducer

Blue – flow away from the transducer

Hand

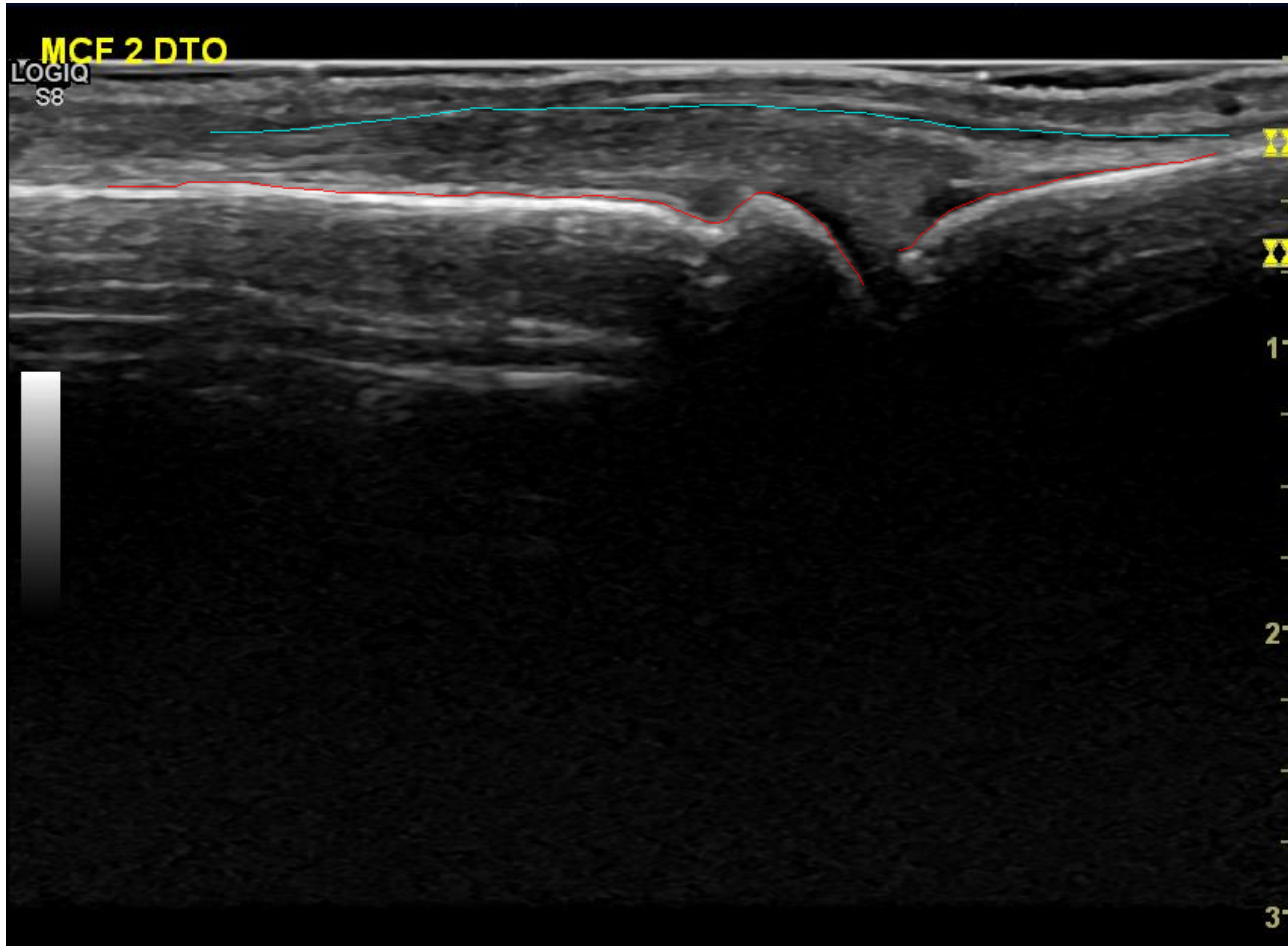
➤ Longitudinal view



PP = proximal falange; MH = metacarpal head; VP = volar plate;
* = articular cartilage; PFT = profundus flexor tendon;
SFT = superficialis flexor tendon; ⇨ = flexor tendon pulley (A1)

Examples

Normal



Red - bone
Cyan - extensor tendon

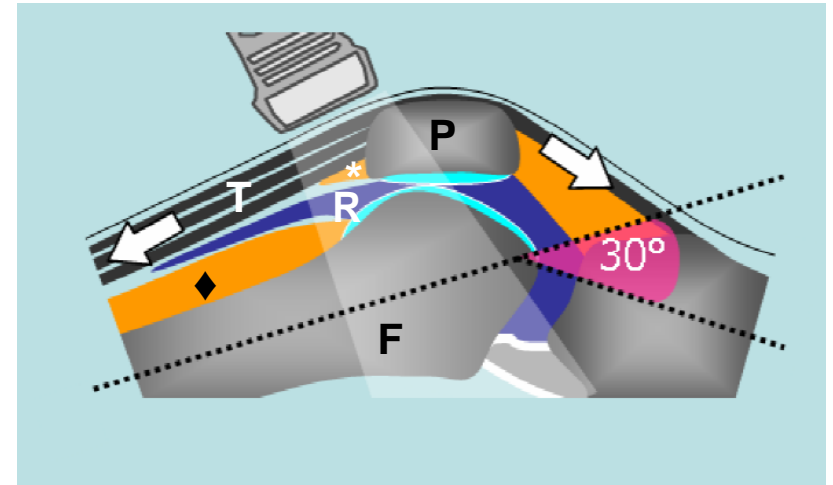
Examples

Pathological



Knee

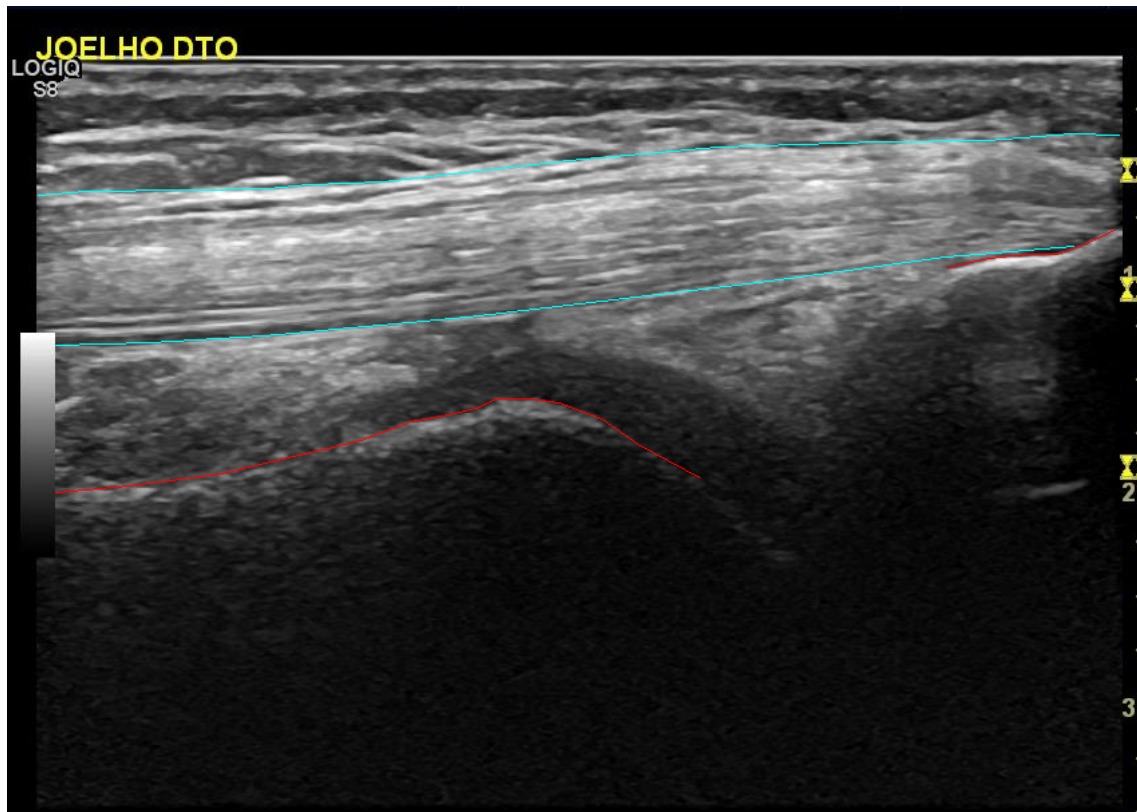
➤ Longitudinal view



T = quadriceps tendon; P = patella; R = suprapatellar recess;
* = suprapatellar fat pad; ♦ = pre femoral fat pad; F = femur

Examples

Normal



Red - bone
Cyan - tendon

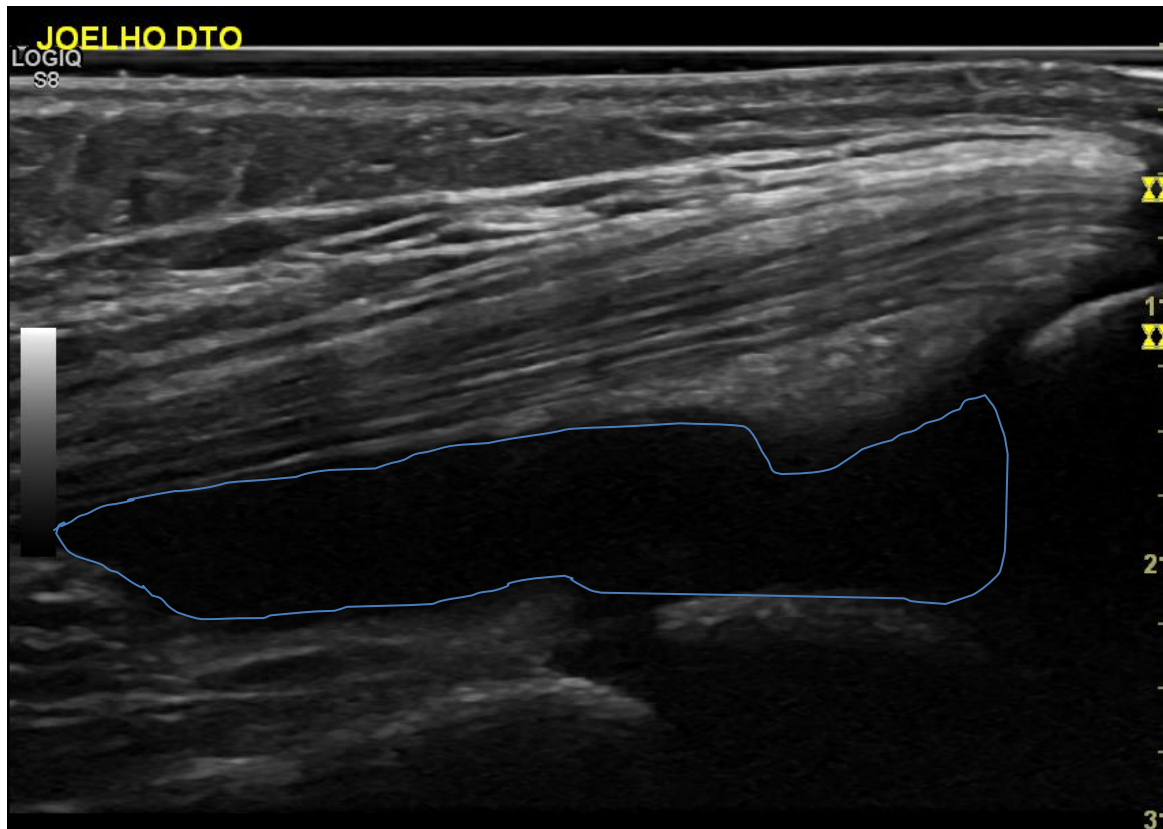
Examples

Normal



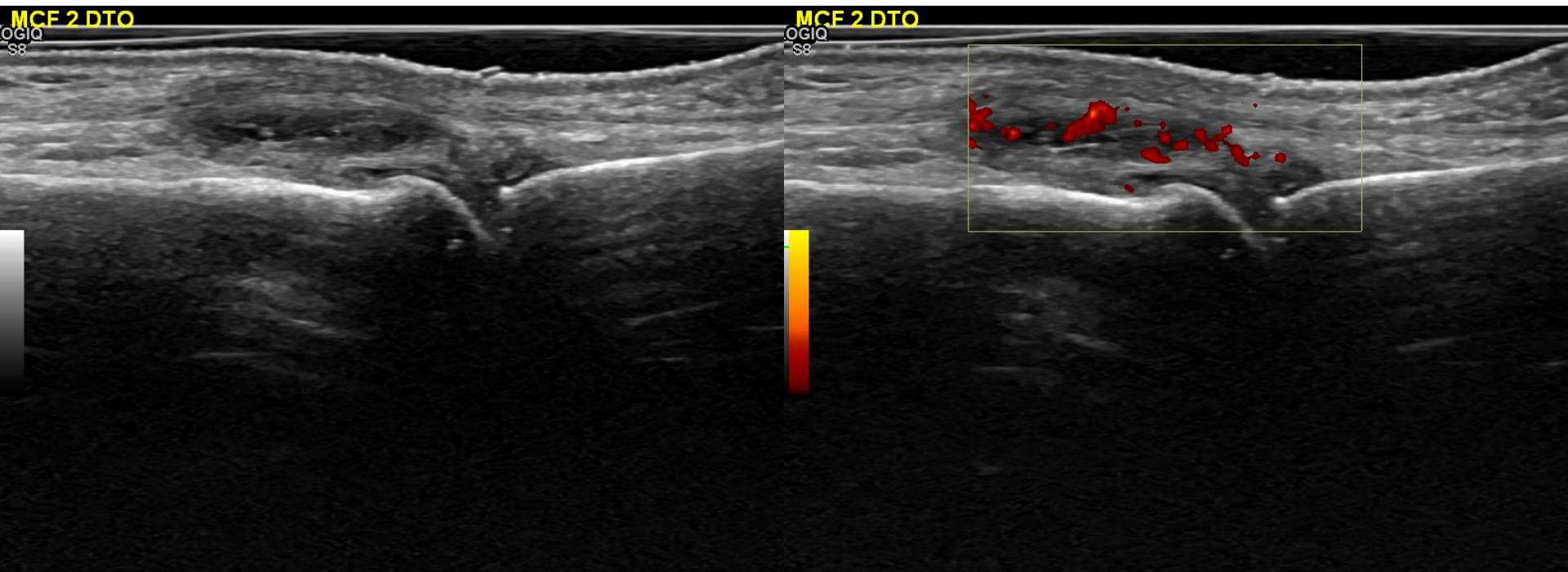
Examples

Pathological



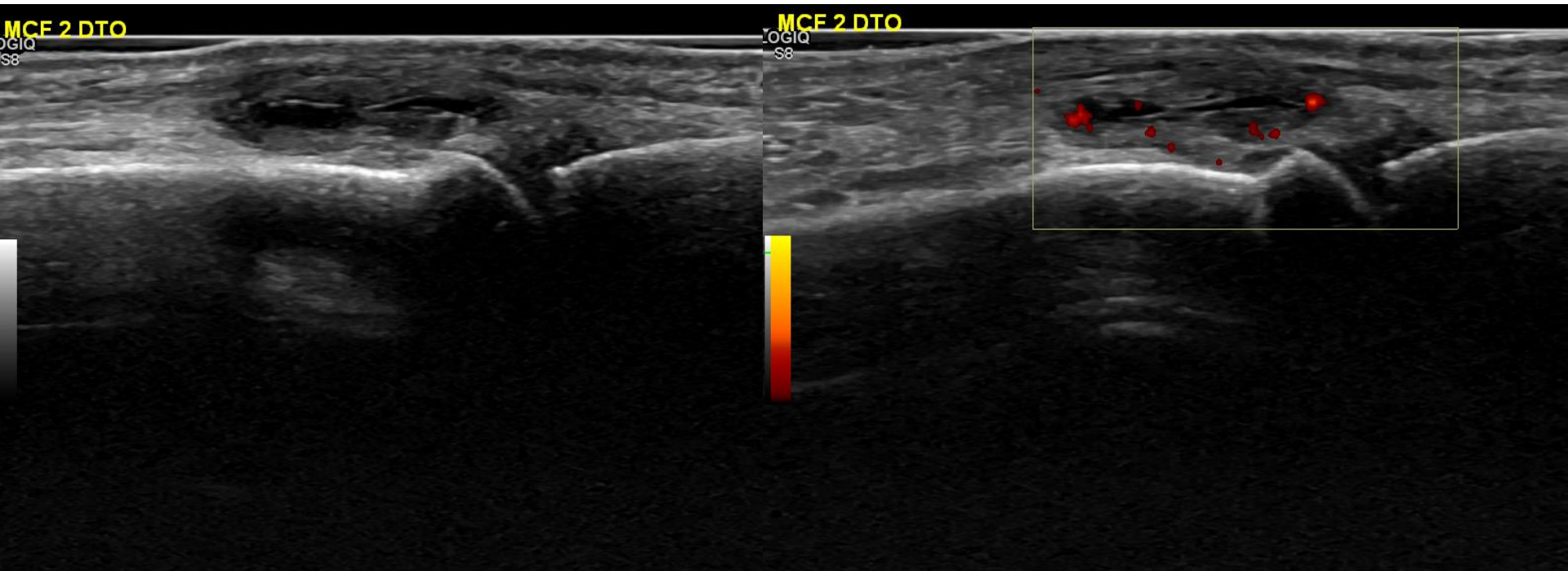
Rheumatoid arthritis

- In early rheumatoid arthritis, **synovitis** appears to be the primary abnormality responsible for structural joint damage



Rheumatoid arthritis

- Response to treatment – one month later



Rheumatoid arthritis

- Bone erosion





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