

DOCTORAL TRAINING SEMINARS: RESEARCH PROJECTS IN
THE DEPARTMENT OF ELECTRONIC ENGINEERING

Suitable **non-invasive measurement** procedures, for determining of physical properties of **materials and** real-time **process** monitoring.

Sensor Systems Group, GSS

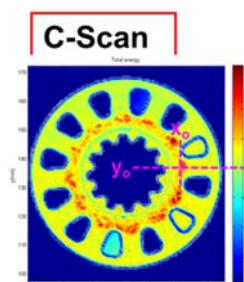
Miguel J. García / Jordi Salazar

<February 21th, 2014>

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Measurements: Necessities and Challenges

- Frequently it is necessary to make measurements:...
 - Without sample destruction (NDT, non destructive test)
 - Without sample alteration
 - Without sample penetration
 - or, contactless
- Sometimes involving unconventional environments.
- New challenges are formulated, overflowing conventional instrumentation concepts.



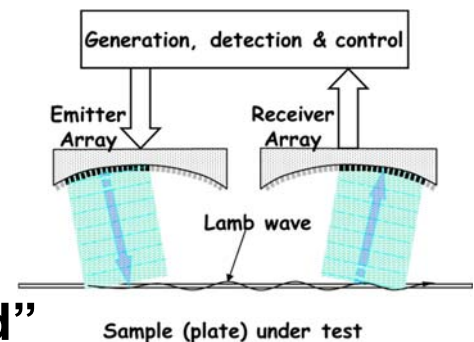
Finding a Solution

- Each solution, is usually an original and specific solution for each particular challenge
- But thinking on what we have done in recent years, we have found a slogan (or a couple of):

“Put a **wave** inside” the
measurand ...

or ...may be

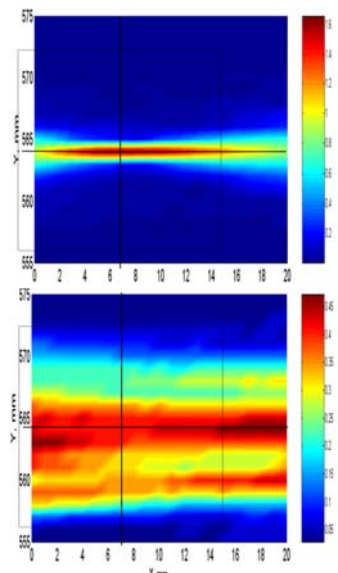
“Penetrate it with a
electric/magnetic/acoustic **field**”



How we do the work.

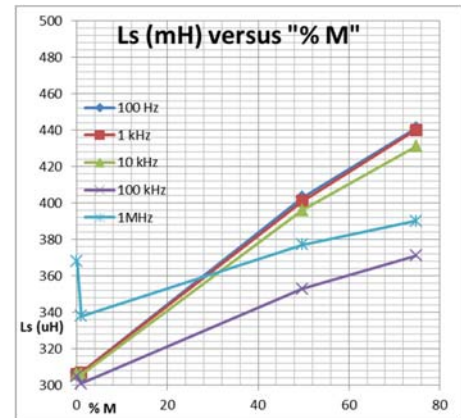
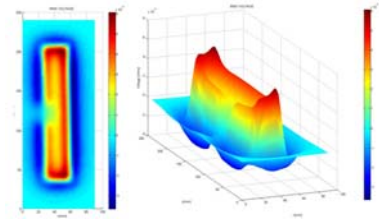
By putting **waves** and **fields** inside, and
observing how they are affected

- For the WAVES, we are using
 - **Ultrasound Waves (US)** and,
 - EM Waves: **Infrared SpectroPhotometry (IR)**
- The Fields we use are:
 - Low frequency **Magnetic Fields**
 - Low frequency **Electrostatic Fields**
- And...Usually **indirect measurement** concepts are involved,

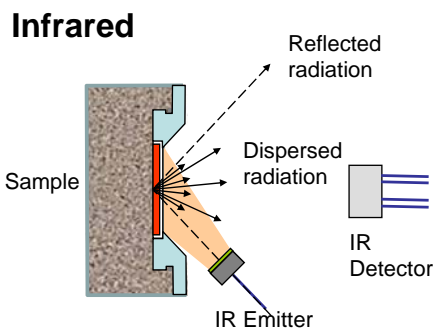


Generics Techniques we Use

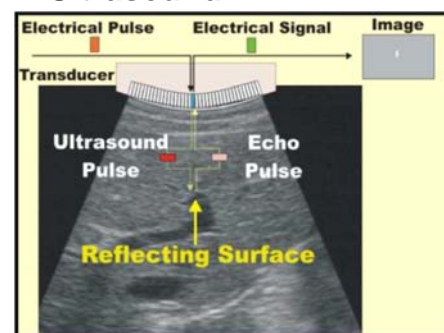
- **Conceptual study:**
 - Understanding of measurement problem.
 - Identification of associated phenomena.
 - Establishment of working hypotheses.
- **Measurement system design:**
 - Proposals.
 - Evaluation and
 - Selection.
- **Embodiment of the system:**
 - General Modeling.
 - Excitation signal.
 - Signal recovery.
 - Signal Processing.



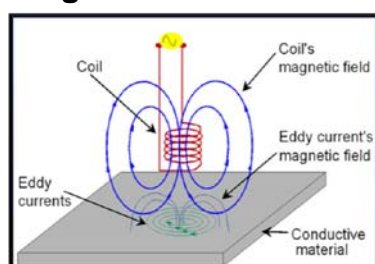
Specific Technologies



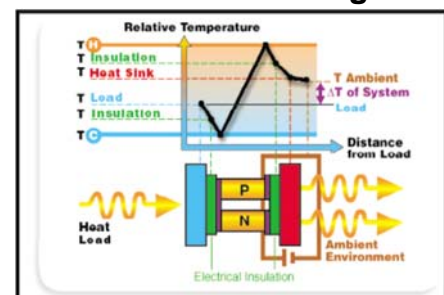
Ultrasound



Magnetic induction

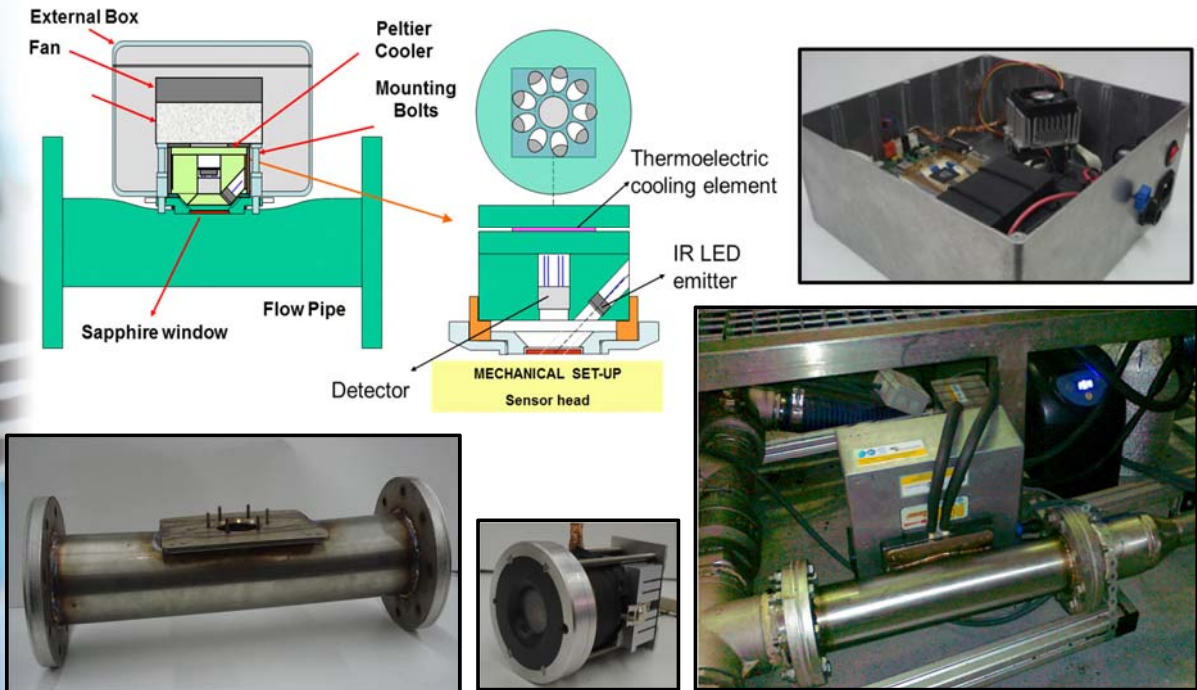


Thermoelectric cooling



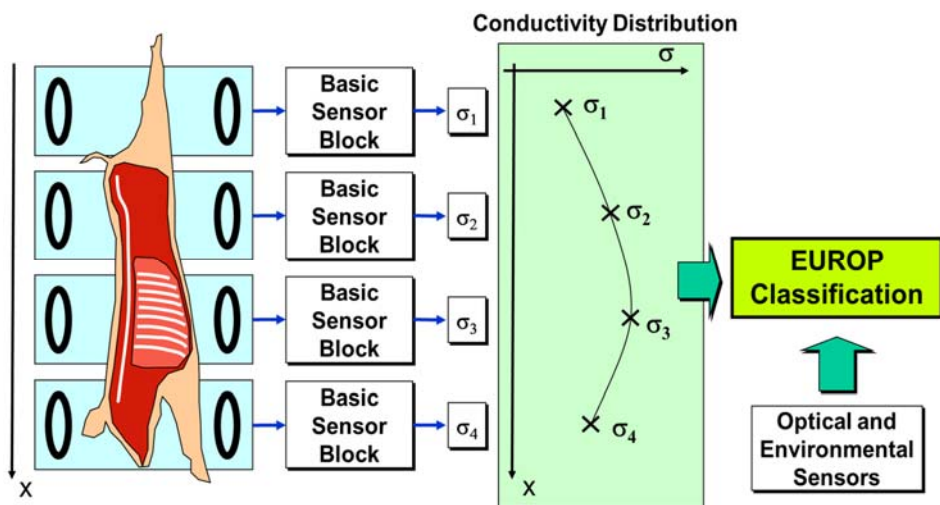
CRAFT Project (EU)

- Development of a novel, cost effective technique to optimise olive oil production - OLIVEMATIC-



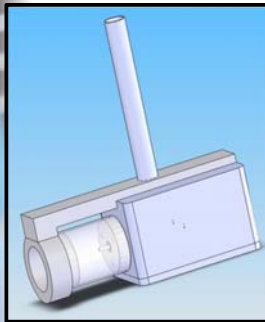
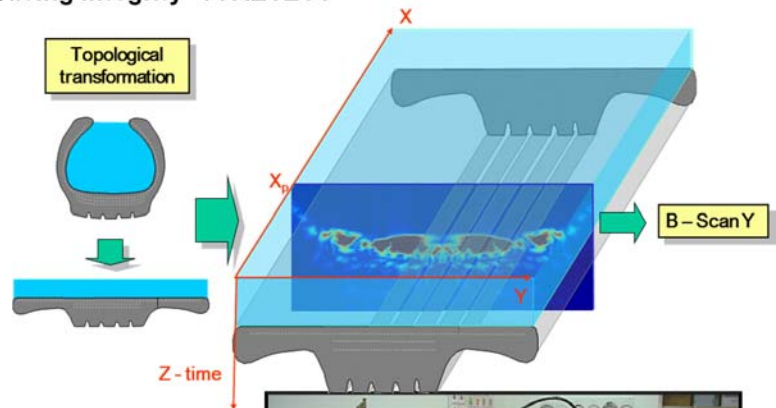
CRAFT Project (EU)

- Automatic non-invasive system for EUROP carcass grading of swine, beef and lamb using cross sectional electrical conductivity -MEATGRADING-



CRAFT Project (EU)

- Development of a low cost non-destructive inspection equipment to improve the assessment of the tyre casing integrity -TYRETEST-

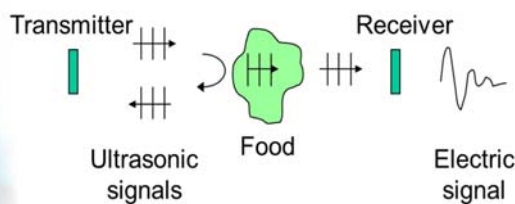


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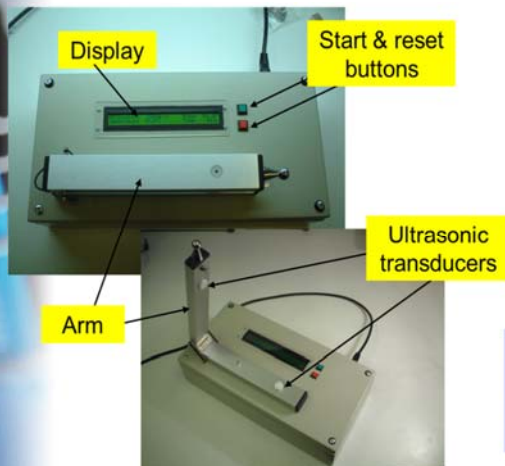
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CRAFT Project (EU)

- Development of an ultrasonic rheological sensor for non-invasive and non-destructive evaluation of dough -RHEODOUGH-



Ultrasonic wave parameters can be related to the **physical properties of the material** such as **density, elastic modulus, hardness, grain structure, composition**, and others.



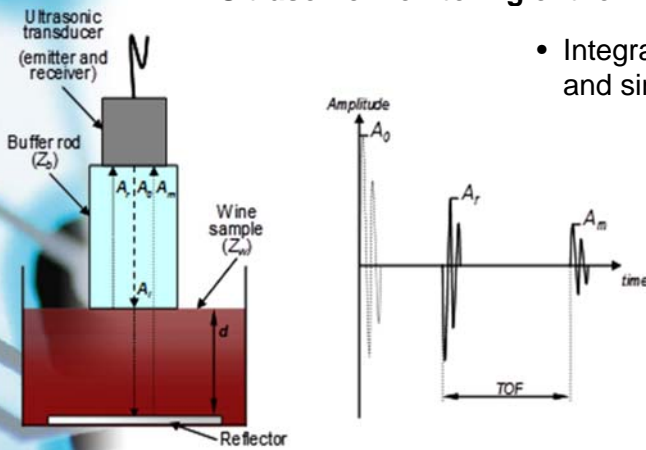
Further information can be found by contacting
McQueen Cairns Technology in London.
Email: mail@mcqueen-cairns.com
Tel: + 44 208 400 1020
www.mcqueen-cairns.com/products_rheological.html

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CICYT Project

- **Ultrasonic monitoring of the malolactic fermentation process -WINESONIC-**
- Integrated measuring system which allows automatic and simultaneous monitoring of up to 4 MLF.



- Ultrasonic sensor head with temperature sensor inside for temperature compensation.



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Compiling, Summarizing and Concluding

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Sensor Systems Group

- The Sensor Systems Group was established in October 1993
- The Group is currently composed of:
 - 5 Ph.D. Graduates
 - 2 Ph.D. Candidates
 - 1 Laboratory technicians
 - Several M.Sc. Graduate students
- The Group has at its disposal:
 - Two laboratories
 - Test and measurement instrumentation
 - Computer-controlled scanning systems

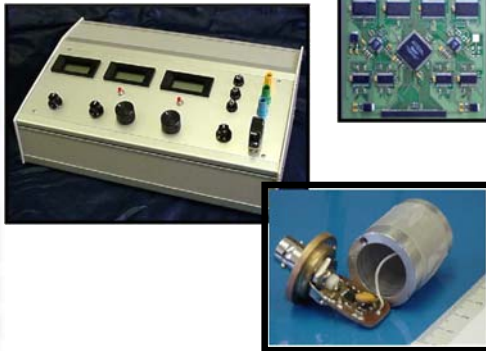


Scientific Indicators

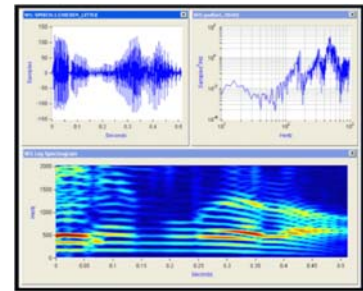
- **Ph.D Thesis Supervised: 9 completed, 2 pending**
- **Publications**
 - **Papers: 94**
 - **Books: 3**
 - **Book Chapters: 3**
- **Participation in R+D Projects: 36**
- **Patents: 6**

R+D Activities

Development of specific measurement instrumentation and sensors



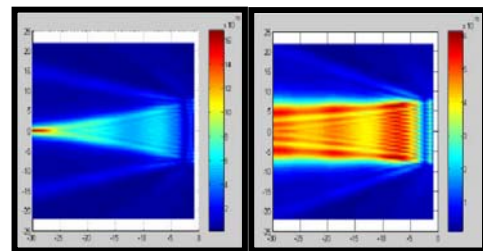
Signal processing



Training



Design, simulation and modelling



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Industrial Applications

- Quality and safety in the Food industry
- Non Destructive Testing in the Aeronautic and Automotive industry
- Safety in the Automotive industry
- Self-powered systems
- Environmental monitoring systems
- Medical instrumentation
- Esthetical instrumentation
- Compact thermocooling systems



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Scientific Networks

- "SICURA" Network
Spanish Network for Food Safety
(Managing Committee)

<http://redsicura.iata.csic.es/>



- "Food for life Spain" Technological Platform

<http://www.foodforlife-spain.es/>



Active and open lines of work.

- **QCM based characterization**
 - Biofilm growing structures (Staphylococcus Epidermis)
- **Non-contact Magnetic coupling measurements**
 - Electric conductivity of fluids (Wine fermentation)
 - Magnetic permeability of Stainless steel under deformation
 - Body composition and muscle physiology
- **Ultrasound Elastography**
 - Mechanical properties of body tissues (tumours detection)
- **Non invasive dielectric constant measurement**
 - Real time monitoring of oil in fryers



Sensor Systems Group

Have you any questions?

Let me give a final tip

It will be fabulous,
you become:

a

full engineer

with a

rigorous scientist,

inside

Thanks for your attention