Carmen Torres-Sánchez, PhD, MEng, PGCert, FHEA

From 2013 – Senior Lecturer in Wolfson School of Mech + Manuf Engineering, Loughborough University

2010-2013 – Lecturer in Mechanical Engineering, Heriot-Watt University

2008-2010 – Research Fellowship in Design, Manufacture and Engineering Management, University of Strathclyde

2006-2008 – Teaching Fellow in Mechanical Engineering and 1st year Director of Studies, Heriot-Watt University

2005-2006 – Research Assistant in Industry-led projects: AWE plc, Qinetic.

2001-2003 – Entrepreneur and Youth & Enterprise lobbyist in Brussels

PhD (Heriot-Watt University) in Mechanical Engineering

MEng (University of Granada) in Chemical Engineering

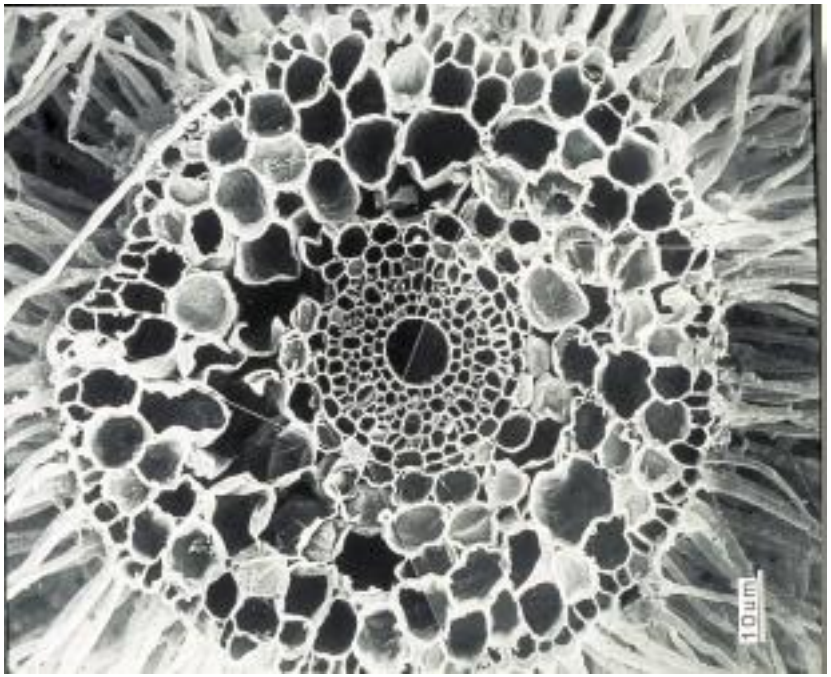
Fellow of the Higher Education Academy

Honorary member of the European Confederation of Junior Enterprises®

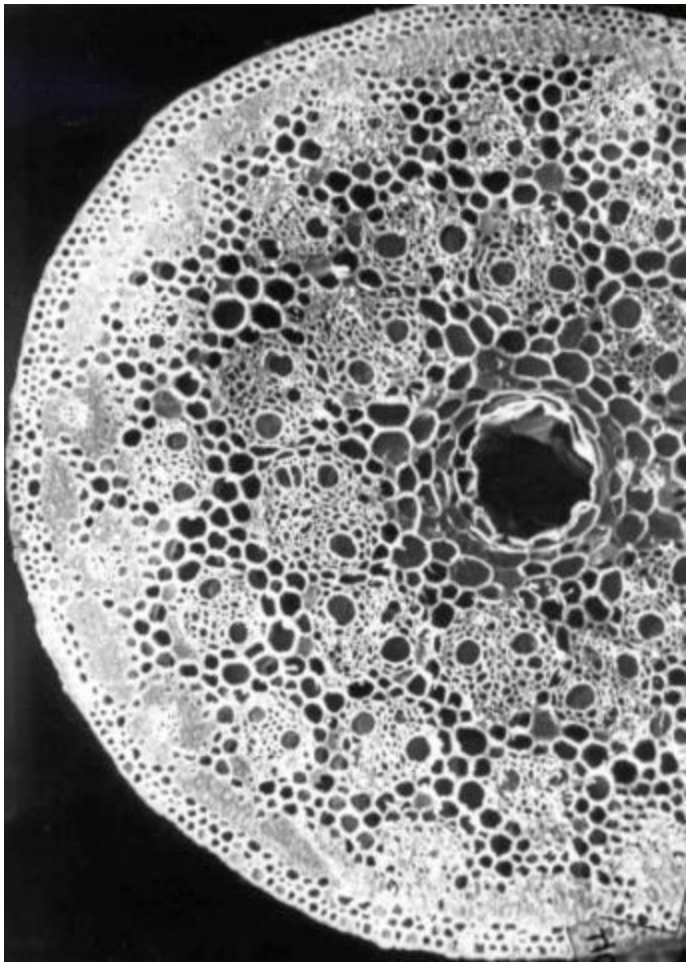
Tailoring structures and Engineering properties

A biomimetic approach

Extraordinary mechanical properties derived from the structure



Root Hair, cryo-SEM preserved. As appeared in www.quorumtech.com on 8th June 2008

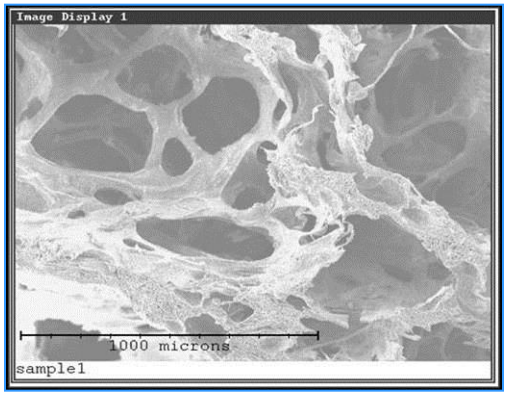


Transverse fracture of the young stem of young Bamboo (*Bambusa sp*) stem demonstrating xylem and phloem bundles and heavily thickened (lignified) epidermal and hypodermal cells. As appeared in www.quorumtech.com on 8th June 2008

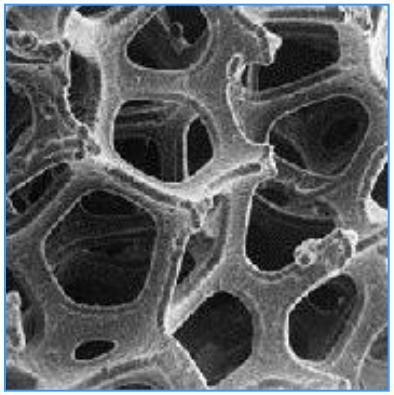
CPD (Critical Point Dryer) Images

Research in Functionally Tailored Structures

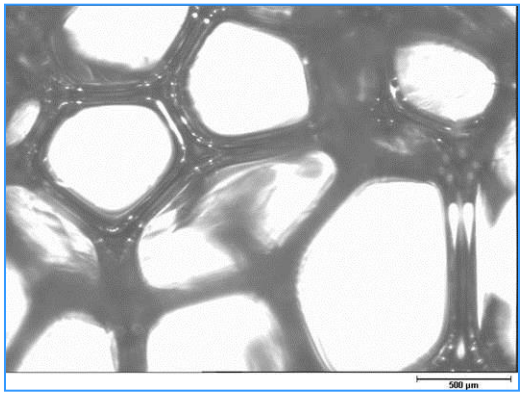
- Worldwide trend: to integrate organic and/or inorganic materials without losing the functionality
- Synergy :: gradients of composition, structure, properties
- Cell differentiation :: how it is affected by external cues, stresses and geometry (and chemistry)
- Applications
  - Biomaterials, packaging, food technology, structural materials
  - Mechanical applications: vibrations, acoustics, thermal (e.g. aerospace)



(a) Natural Sponge*



(b) Generic Metal Foam



(c) Reticulated polymeric foam

*Ref: Yang T.H.J., 2005, Structure-property relationships of biological tissues. PhD Thesis. Heriot-Watt University

Three interesting current projects

- Gentler on the bones *(bone graft bioengineering)*
- A ‘silver bullet’ for BOOM Chemistry *(a new anticancer treatment strategy)*
- Baking with Sound *(tailoring properties using ultrasound in the food industry)*

Gentler on the bones

Engineered scaffolds with biomimetic properties

Sponsors:

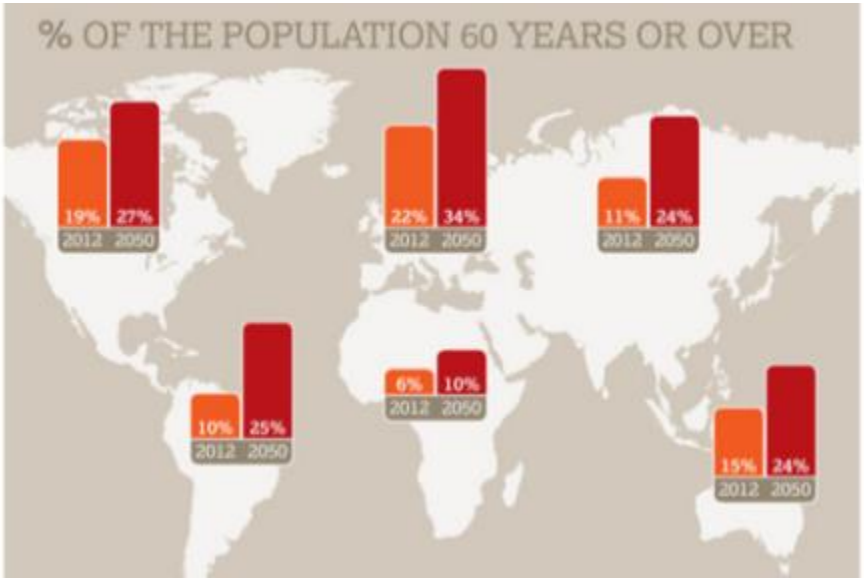
HWU Alumni Fund
Chevron UPP
EPSRC

£285,674

Dr Carmen Torres-Sanchez (PI) et al.
Loughborough University

Dr Steven McDougall et al.
Prof Jingsheng Ma et al.
Heriot-Watt University

Prof Mark Bradley
Dr Gouher Rabani et al.
Dr Emma Johansson
Mr Christopher West
University of Edinburgh



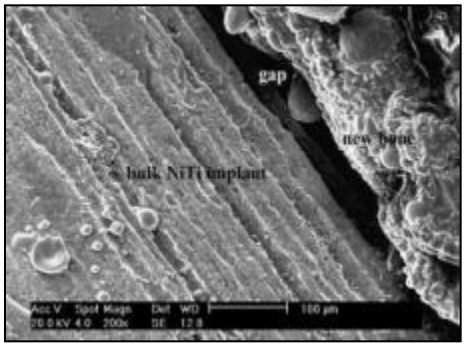
Ref: HelpAge International. url: www.helpage.org

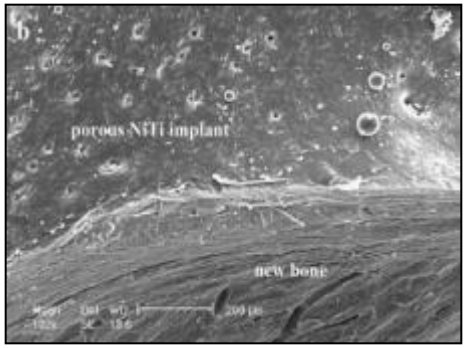
- 25% increase of major orthopaedic surgeries in the next 10 yrs (2010 Datamonitor)
- Patients outliving their implants
- New materials, design and manufacturing processes for the next generation of orthopaedics

Mismatch of the mechanical properties

‘loosening’ effects due to “stress shielding”

Clean-cut interfaces



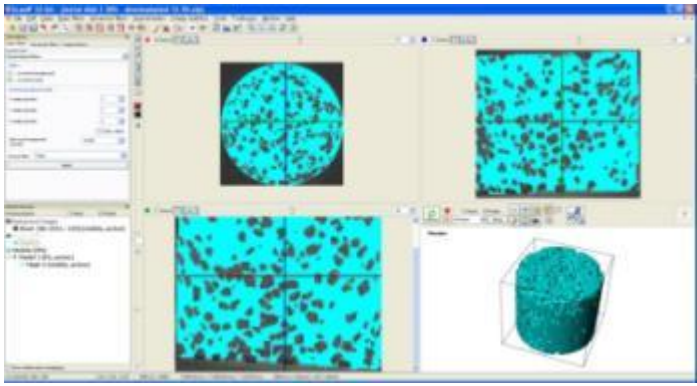


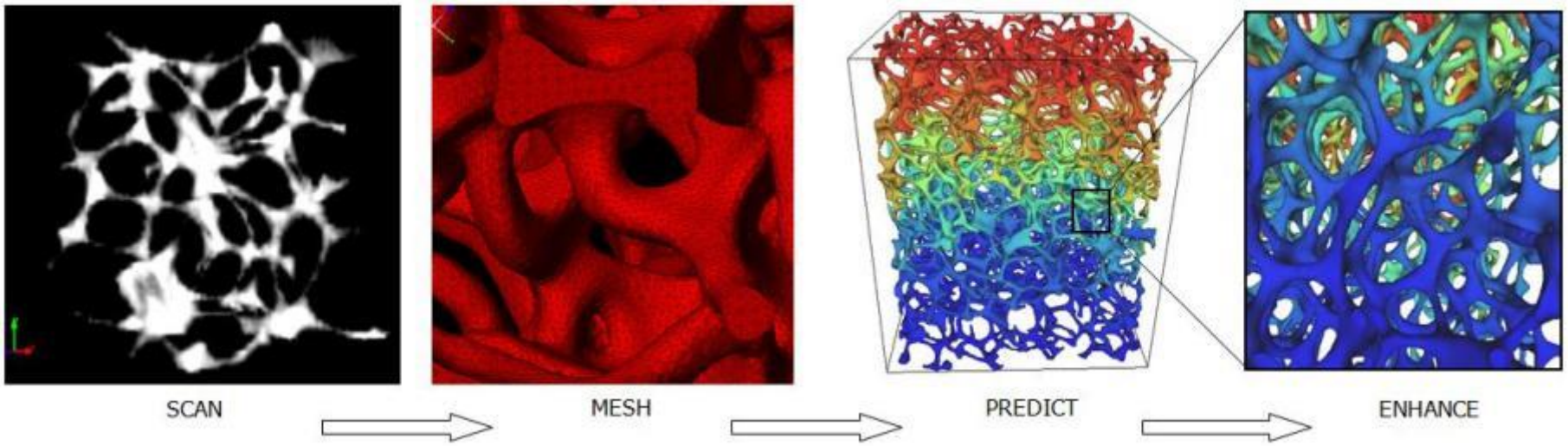
Zhu, S.L., et al., Effect of porous NiTi alloy on bone formation: A comparative investigation with bulk NiTi alloy for 15†weeks in vivo. Materials Science and Engineering: C, 2008. 28(8): p. 1271-1275.

Tailoring mechanical properties

modelling to allow adjustment of an optimal mechanical behaviour

- High porosity structures w controllable features (pore size and distribution)
- High strength, low stiffness
- High superelasticity
- Shape memory alloys

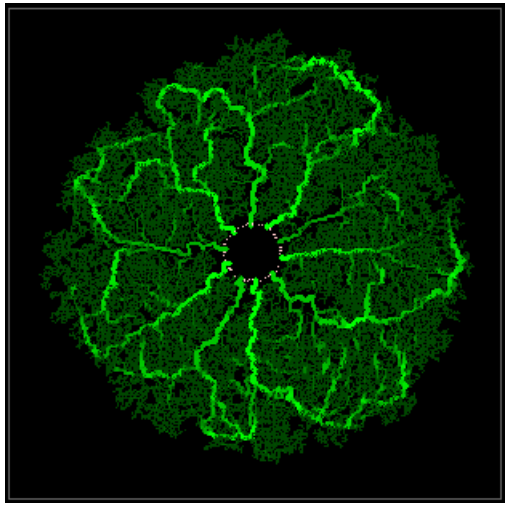




Adjusting permeability

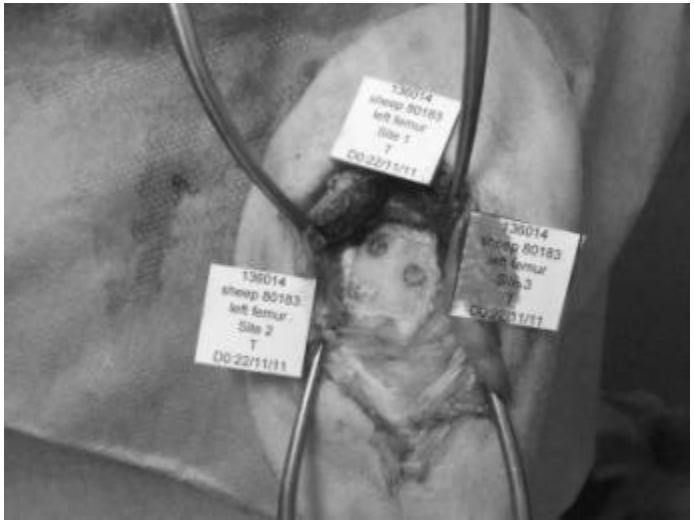
for cell migration and vascularisation

- Discrete cell migration model can be coupled to an existing model of angiogenesis (applied in tumours, bounds and retinae)
- Blood flow and capillary radius remodelling simulated in the nascent networks

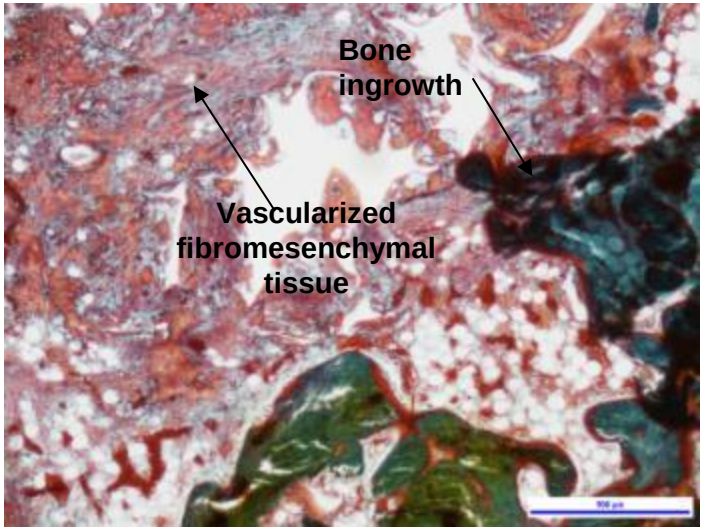


Biological viability

in vitro and in vivo studies



Histological analysis after 4 weeks (sheep femur)



‘Silver bullet’ strategy for anticancer treatment

BOOM chemistry carriers for personalised medicine

Sponsors:

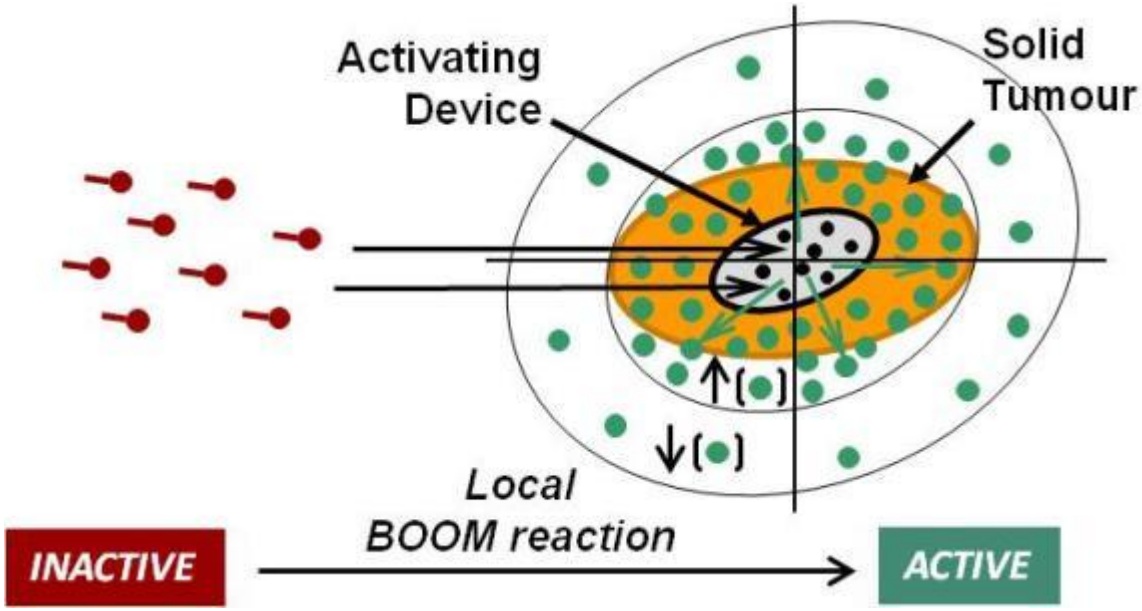
DSM & SULSA
MRC
EPSRC

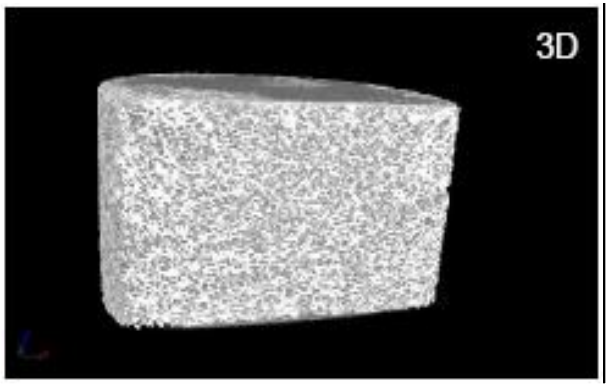
£53,073

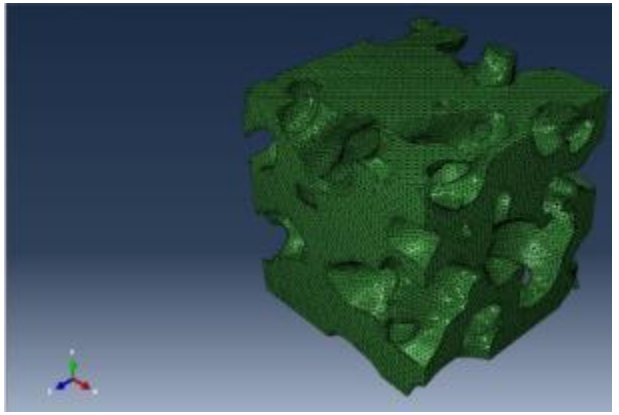
Dr Carmen Torres-Sanchez (PI) et al.
Loughborough University

Dr Asier Unciti-Broceta et al.
Mr Jason Weiss
University of Edinburgh

Mr Mark Duxbury
MRC Edinburgh Cancer Research







- Localised, targeted chemotheraphy treatment of the tumour and reduced toxicity over the healthy cells
- Aids ‘downstaging’ to make the tumour resectable

NATURE COMMUNICATIONS | ARTICLE OPEN

Extracellular palladium-catalysed dealkylation of 5-fluoro-1-propargyl-uracil as a bioorthogonally activated prodrug approach

Jason T. Weiss, John C. Dawson, Kenneth G. Macleod, Witold Rybski, Craig Fraser, Carmen Torres-Sánchez, E. Elizabeth Patton, Mark Bradley, Neil O. Carragher & Asier Unciti-Broceta

Affiliations | Contributions | Corresponding authors

Nature Communications **5**, Article number: 3277 | doi:10.1038/ncomms4277
Received 13 July 2013 | Accepted 17 January 2014 | Published 13 February 2014

PDF | Citation | Reprints | Rights & permissions | Article metrics

Abstract

Abstract • Introduction • Results • Discussion • Methods • Additional information • References • Acknowledgements • Author information • Supplementary information

A bioorthogonal organometallic reaction is a biocompatible transformation undergone by a synthetic material exclusively through the mediation of a non-biotic metal source; a selective process used to label biomolecules and activate probes in biological environs. Here we report the *in vitro* bioorthogonal generation of 5-fluorouracil from a biologically inert precursor by heterogeneous Pd^0 catalysis. Although independently harmless, combined treatment of 5-fluoro-1-propargyl-uracil and Pd^0-functionalized resins exhibits comparable antiproliferative properties to the unmodified drug in colorectal and pancreatic cancer cells. Live-cell imaging and immunoassay studies demonstrate that the cytotoxic activity of the prodrug/Pd^0-resin combination is due to the *in situ* generation of 5-fluorouracil. Pd^0-resins can be carefully implanted in the yolk sac of zebrafish embryos and display excellent biocompatibility and local catalytic activity. The *in vitro* efficacy shown by this masking/activation strategy underlines its

Baking with Sound

Ultrasonic sonication in the processing of healthier foods

Sponsor:

Technology Strategy Board

£497,596

Dr Carmen Torres-Sanchez (Academic PI) et al.
Loughborough University

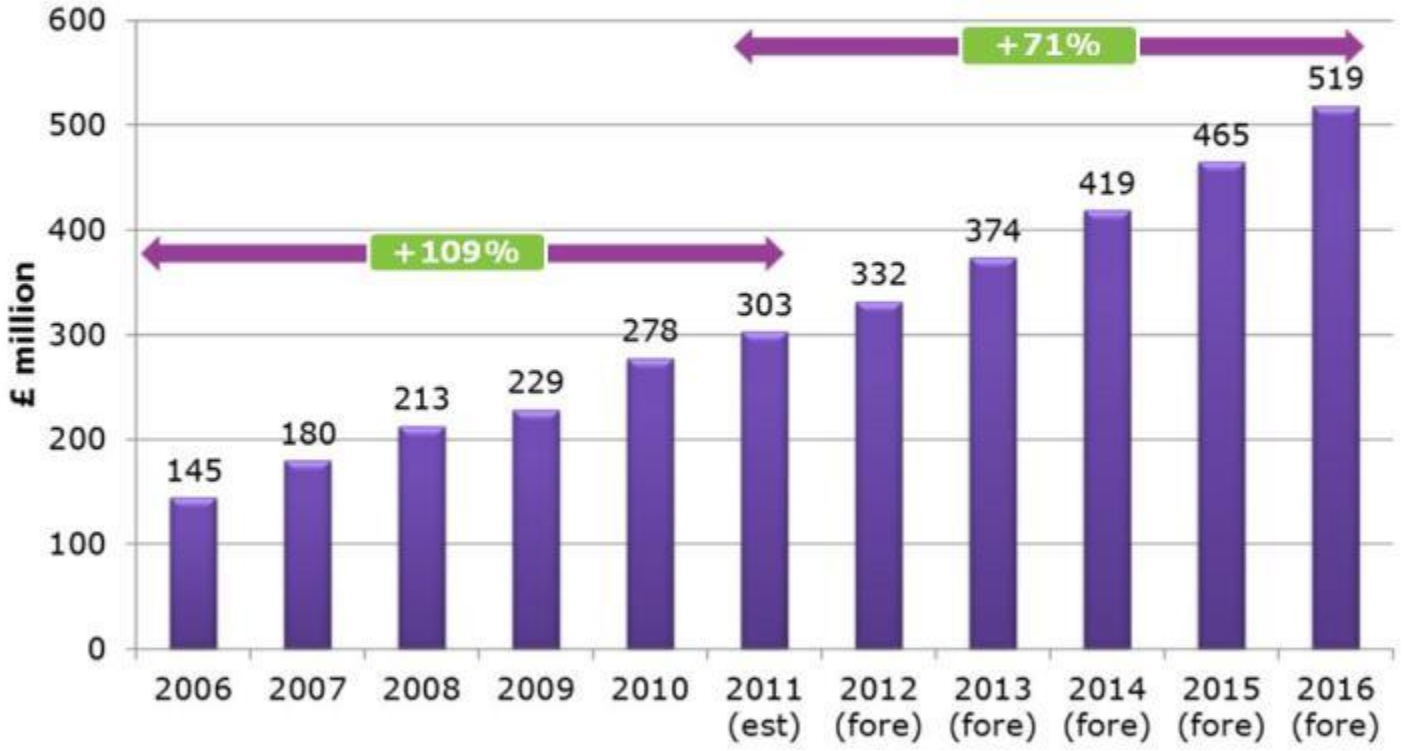
Macphie of Glenbervie Ltd
Nortek Piezo Ltd
MONO Bakery Equipment (AFE group)
Fosters Bakery Ltd

Industrial partners

Free-from market: Salt reduction and Gluten-free products

UK free-from market growth will slow but is still impressive

UK retail sales of free-from foods, 2006-16



Source: Mintel Oxygen

Control	Sonicated

TSB project awarded (spring 2012)

↑

Technology Strategy Board project preparation (Autumn/Winter 2011)

Consortium of 4 companies and 1 University

↑

From benchtop to factory kitchen (Spring/Summer 2011)

Macphie's recipes and equipment

↑

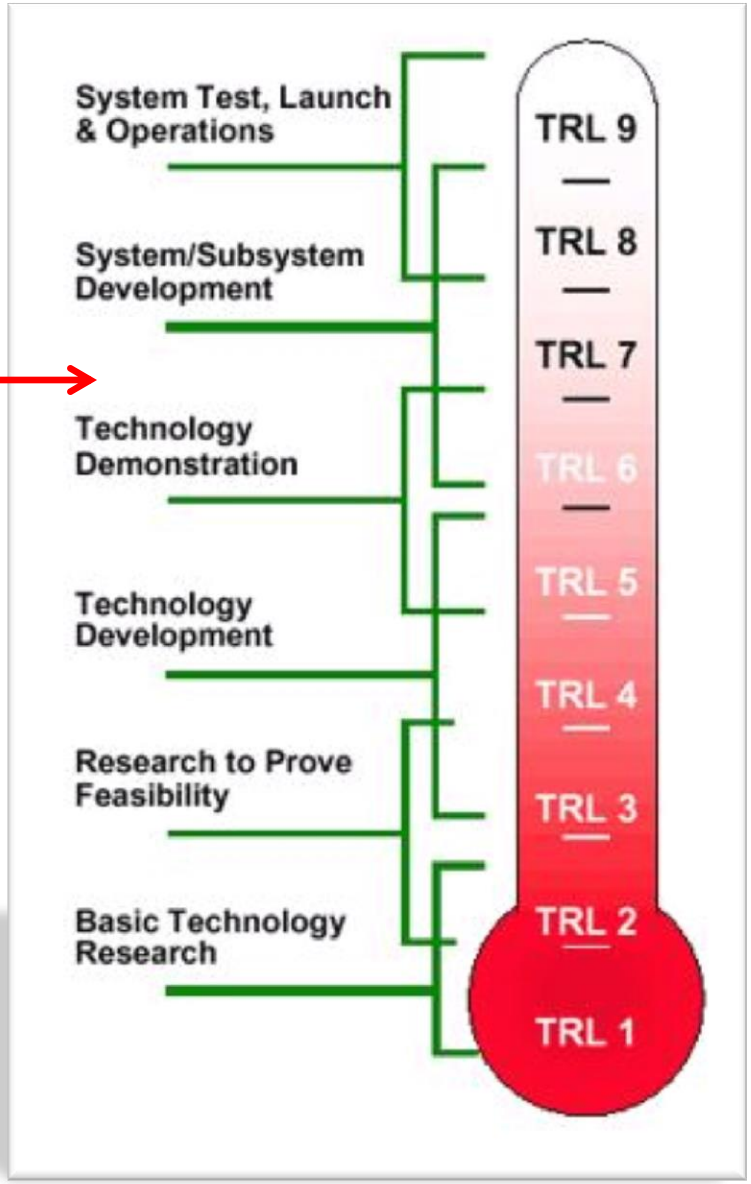
Feasibility study at HWU (Autumn 2010)

EDTC grant supported by Macphie

↑

Summer student project (Summer 2010)

Based on work done on polymeric structures

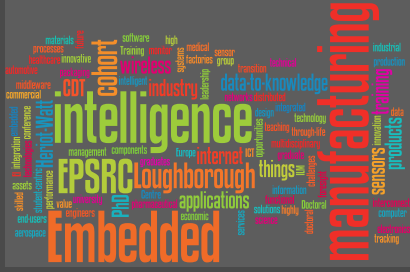


NASA Technology Readiness Level

Centre for Doctoral Training in Embedded Intelligence

A multidisciplinary approach

Embedded Intelligence



- Integration of intelligence into products, processes and services
  - So they work better
  - To increase productivity, efficiency and connectivity
- Embedded intelligence is more than just combining a sensor and processing it is characterised by reflection on operational performance, usage load or in relation to end user or environment. It is facilitated by local and/or remote processing to derive knowledge, understanding and insight
  - Requires orchestration of several disciplines

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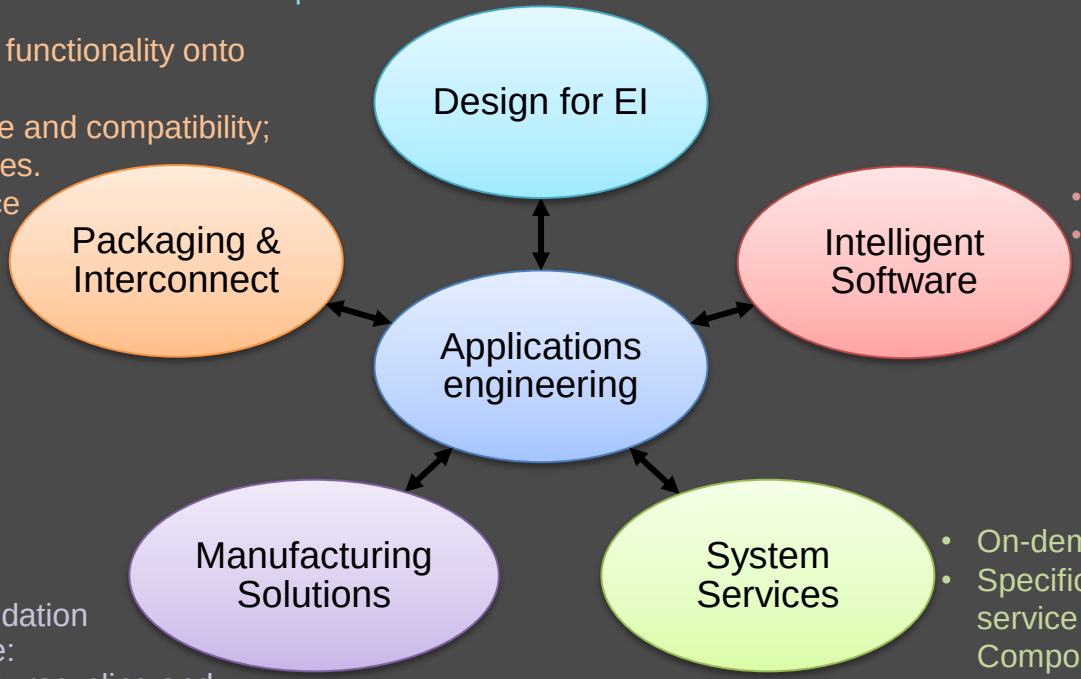
cdt-ei@lboro.ac.uk
www.cdt-ei.org

Technical areas

- Applications to dictate the technology solution sets.
- Determine solution spaces for: sensor modalities; communications; power; processors;
- Multi-variable design trade-off techniques (cost, quality, time and effectiveness);
- Design of standard platforms of hardware and software on an open-research basis



- Physical partitioning of functionality onto components / chipsets
- Packaging for cost, size and compatibility;
- Assembly methodologies.
- Reliability and resilience
- Wafer level packaging
- Packaging materials

- Semantically model relationships;
- Diagnostic and prognostics;
- Information infrastructures;
- Reliable, resilient integration;
- Layered ontologies, mapping data
- Compatible source-target semantics
- Semi-automated linking
- Bayesian networks

- Process consolidation
- Cradle-to-cradle: remanufacturing, recycling and re-use
- Biomimetics and biomorphism, mechanobiological fabrication
- EI in processes for Industry 4.0 features

- On-demand lifecycle service systems
- Specification, design and creation of service system: (Foundations; Composition; Management and Monitoring; Design and Development)
- Service and lifecycle requirements to support integration and co-operation of components and services.
- Optimisation of the services for efficiency across the lifecycle.

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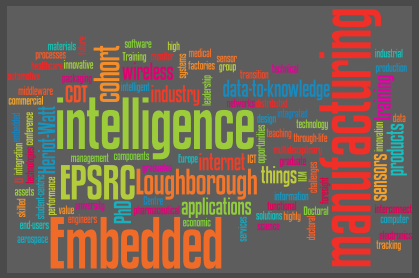
The graduates



- From a technical viewpoint, our graduates will be ‘T-shaped’
  - Focused technical depth and expertise from PhD research
  - Exceedingly competent and conversant across the multiple disciplines that encompass EI
- Training will deliver effective members of multidisciplinary teams, naturally collaborative and…
  - Capable, comfortable and confident with:
    - Leading multidisciplinary teams
    - Negotiating and managing commercial and technical relationships with clients
    - Understanding of value of their intellectual capital and routes to exploitation
    - and, shall value and utilise their extensive network of peers and collaborators and alumni.

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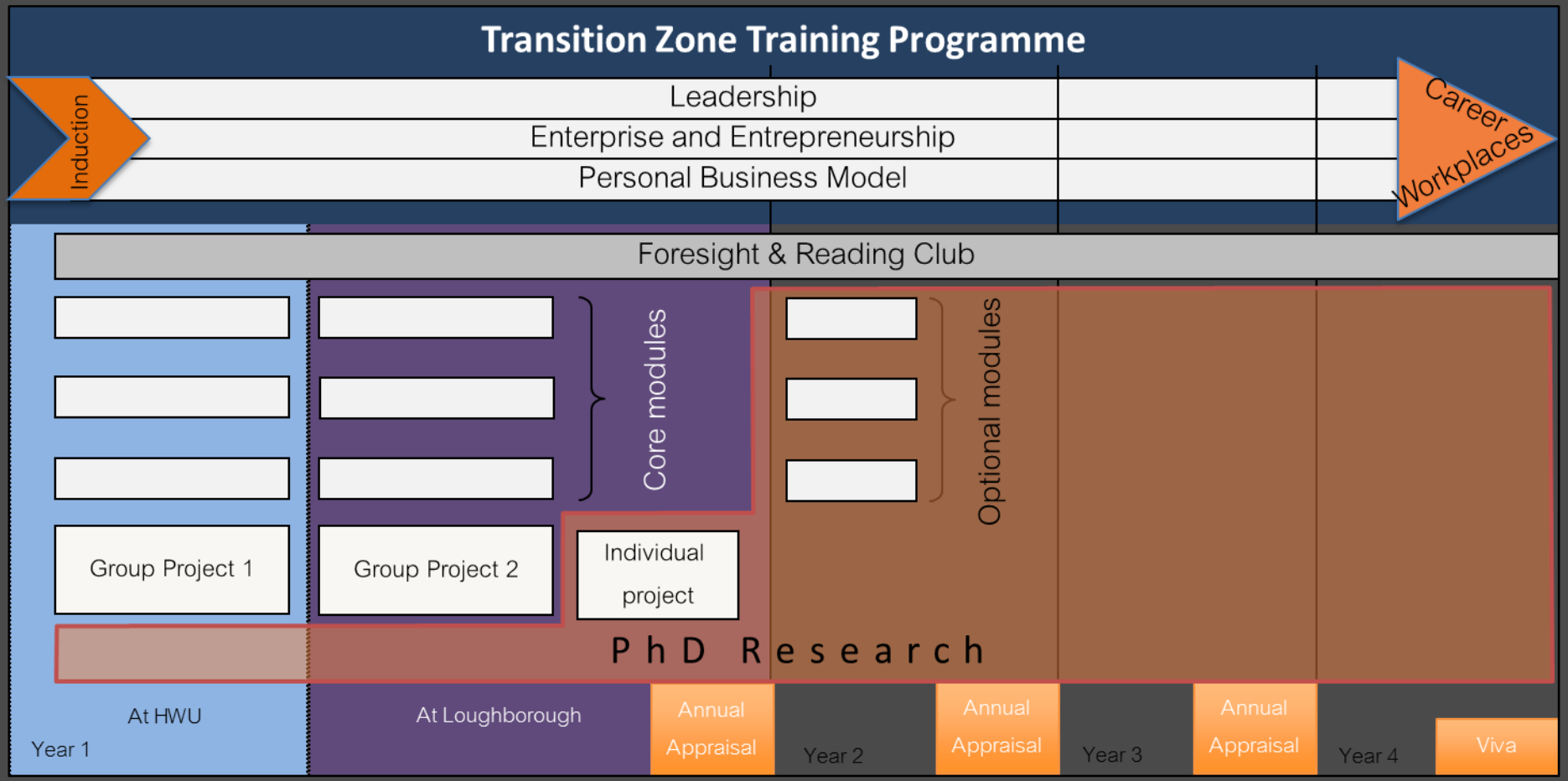
Training for becoming conversant in Embedded Intelligence



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Training approach

- ***The "Transition" Zone**:* non-technical training to facilitate the transition into the centre and the exit as an employable high value graduate
- ***Cohort-forming and personal research roadmapping**:* with a "Foresight" module (specialist seminars) and a Reading Club
- ***Industry-led projects and on-demand industry training packages**:* group and individual projects with our core industry partners and personalised on-the-floor training activities
- ***Technical Foundation:*** core and elective modules to make a cohort conversant on all aspects of embedded intelligence

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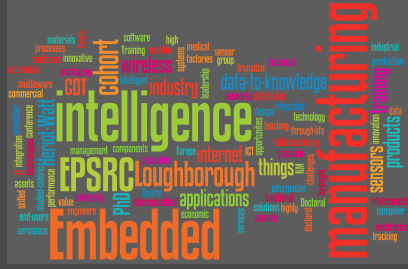
EPSRC Centre for Doctoral Training in Embedded Intelligence



- £13.6M over 8.5 years
- Funding for
  - 5 intakes of students, starting Oct 2014
  - 4 year PhD, integrated technical and personal CPD training with industrial mini projects and an industry-focused PhD
  - Support for 87 studentships secured
    - All potentially industry sponsored
    - 75 at Loughborough Uni, 12 at Heriot Watt Uni

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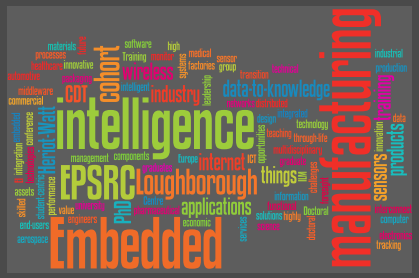
The partnership



- Two universities involved, 7 x schools, 45 supervisors
  - Loughborough (lead)
    - Mechanical & Manufacturing Engineering
    - Design School
    - Electronic, Electronic and Systems Engineering
    - Aeronautical and Automotive Engineering
    - Centre for Information Management
  - Heriot-Watt
    - Engineering and Physical Sciences
    - Mathematical & Computer Science
- 20 Industrial & research partners (…and growing)

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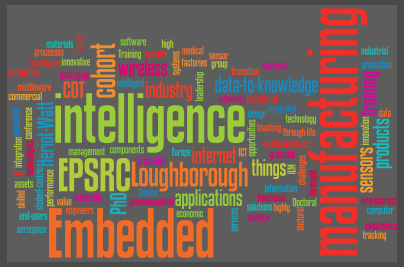

The Integration of Intelligence into products, processes and services, so they work better and productivity, efficiency and connectivity can be enhanced

Embedded intelligence is more than just combining a sensor and data processing. It is characterised by reflection on operational performance, usage load, or in relation to end users and environment, to derive knowledge and insight

- 4 year programme
- Stipend (£16.7k p.a.) + fees
- Personal budget (£10k)
- Student-centred, flexible 'transition' training
- Cohort-based activity
- Practice-based learning with industry

- Cross institute supervisors
- 45 experienced staff
- CDT support hub
- Industry-sponsored
- Loughborough, Edinburgh and London campuses
- Sept 2014 start

Loughborough University

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CDT in Embedded Intelligence

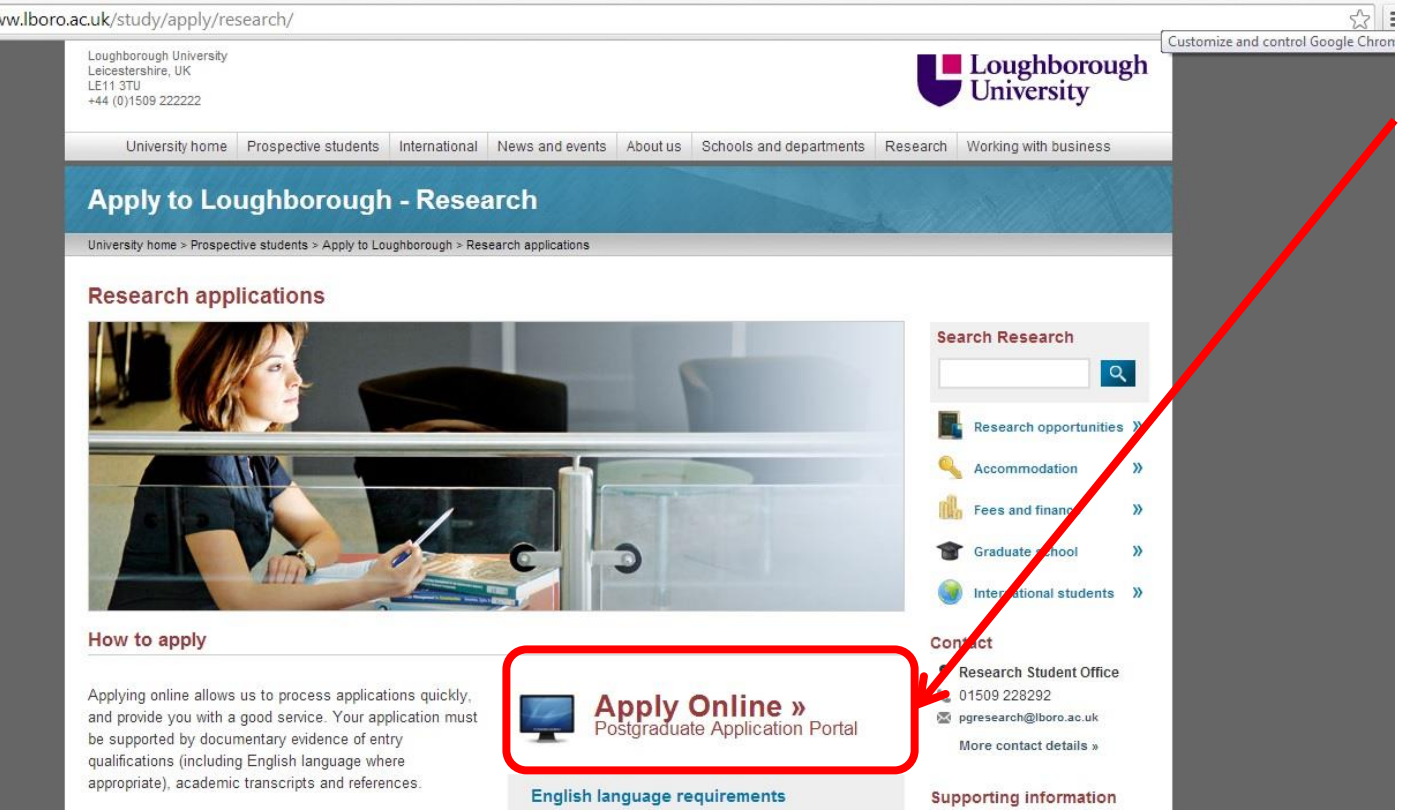
How to apply

Visit

www.cdt-ei.org

or direct link

http://www.lboro.ac.uk/study/apply/research/



Application form:

- Personal details
- Select "Embedded intelligence MME" in drop-down menu
- 2 Referees
- No need to select a project (yet!)
- Interviews over the summer at sponsoring companies sites

Thank you