# The Healthy Aims Project

**Presented by Diana Hodgins**

**Project Co-ordinator,**

**26 September 2005**

# Electronics in medical implants

- These include some under development, and some in production:
  - Retina implant
  - Cochlear implant
  - FES system a range of applications including movement for lower and upper limbs
  - Pressure sensor for brain cavity and aorta
  - Pacemakers

# Electronics in diagnostic equipment

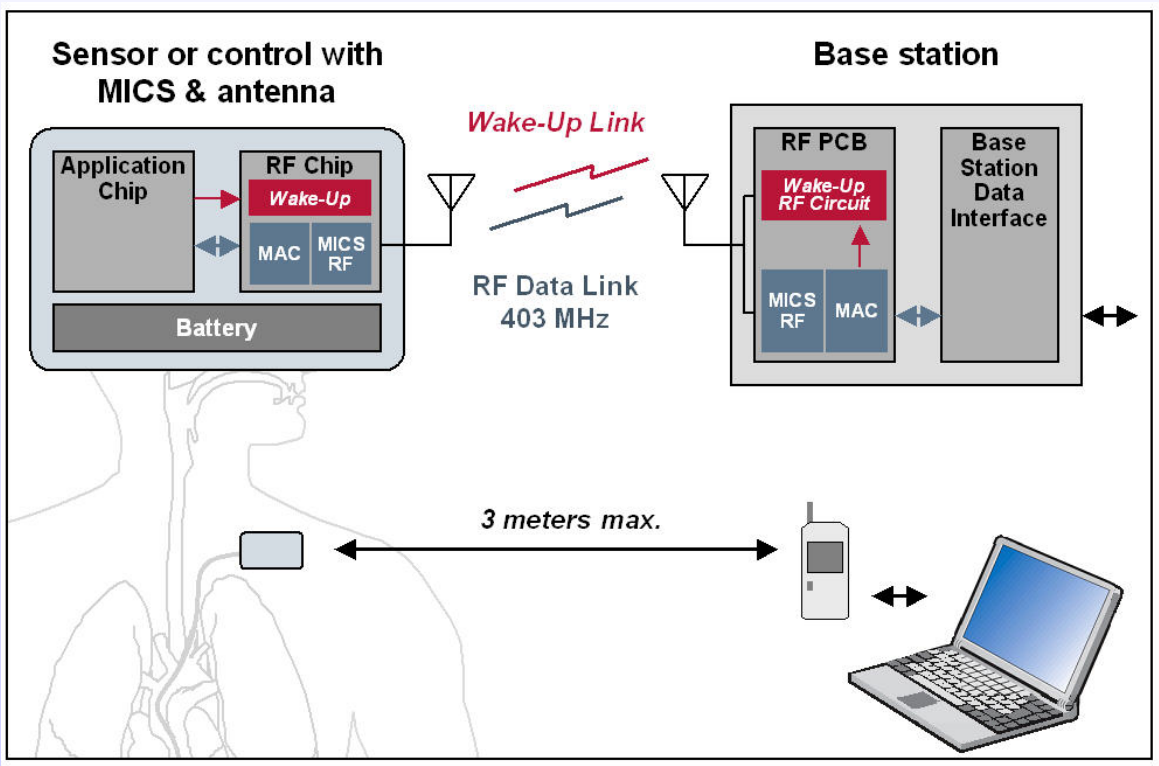
- These include some under development, and some in production:
  - Camera pill
  - Sphincter sensor
  - Urodynamics pressure sensor
  - Glaucoma sensor

# Wireless communications for implants

Implant must be MICS compatible (402 – 405 MHz / 433MHz). Typical specification is:

- Downlink 250 Kbit/s, Uplink 500Kbit/s
- Power output limited to 25μW EIRP
- Range 1.5 – 3.0 metres

# System Overview for implants




ZARLINK SEMICONDUCTOR

Information Society

# Wireless communications for diagnostic equipment

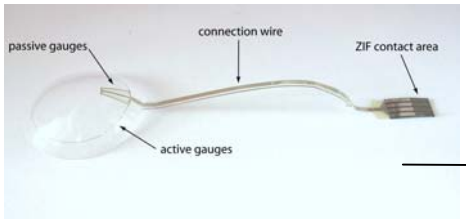
Range of frequencies acceptable for on the body applications, from the ISM (Industrial, Scientific and Medical) bands for Europe and Africa.

| | |
|---|---|
| 13 553 - 13 567 kHz | (centre frequency 13 560 kHz) |
| 26 957 - 27 283 kHz | (centre frequency 27 120 kHz) |
| 40.66 - 40.70 MHz | (centre frequency 40.68 MHz) |
| 433.05 - 434.79 MHz | (centre frequency 433.92 MHz) |
| 2 400 - 2 500 MHz | (centre frequency 2 450 MHz) |
| 5 725 - 5 875 MHz | (centre frequency 5 800 MHz) |
| 24 - 24.25 GHz | (centre frequency 24.125 GHz) |

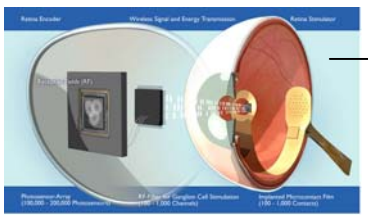
# The Healthy Aims IST Project

- 25 EU partners are developing a range of medical implants and diagnostic equipment which incorporate medical electronics:
  - Retina implant
  - Cochlear implant
  - FES system for lower and upper limbs
  - Sphincter sensor
  - Glaucoma sensor
  - Pressure sensor for brain cavity and aorta

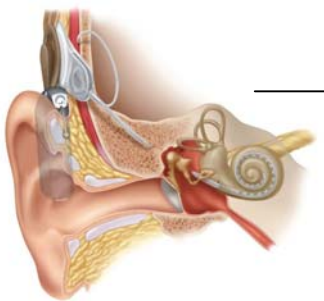
# European Technology for Business Ltd



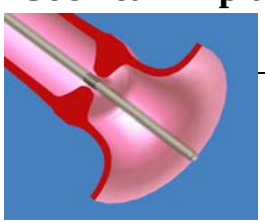

Glaucoma Sensor



Retina Implant



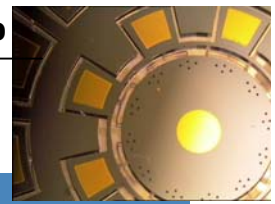
Cochlear Implant

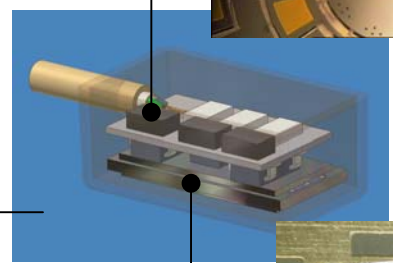


Sphincter sensor

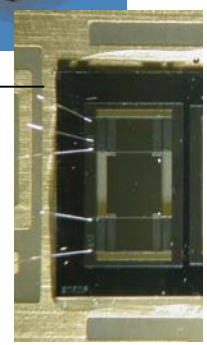
Intracranial Pressure Sensor

Gyro



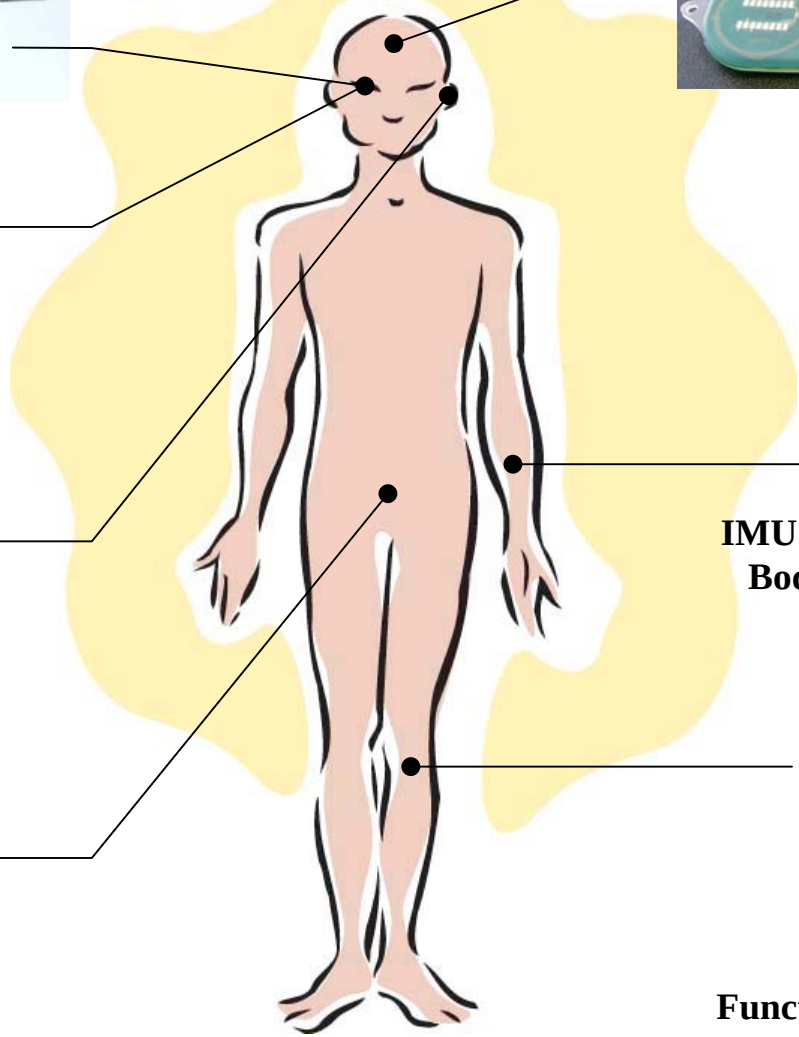


IMU for Human Body Motion



Accelerometer

Functional Electrical Stimulation



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# The medical devices utilise a range of ‘electronics’

Electronic components – some active, some passive.

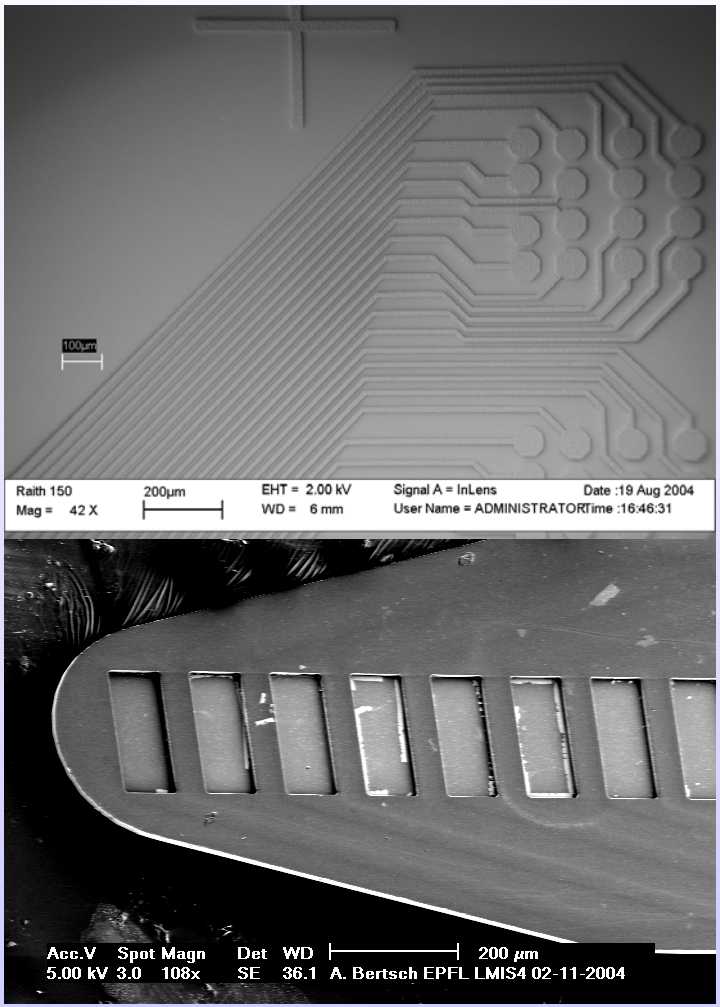
Implantable energy source.

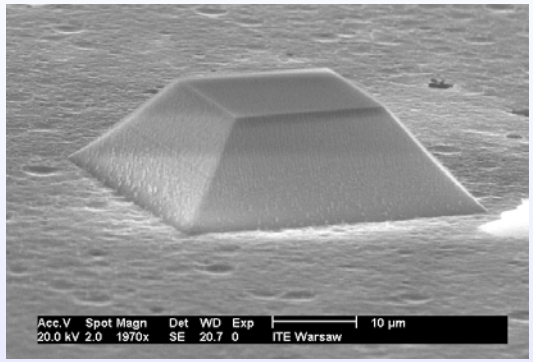
The Body Area Network to communicate from in or on the body to base station up to 3m away.

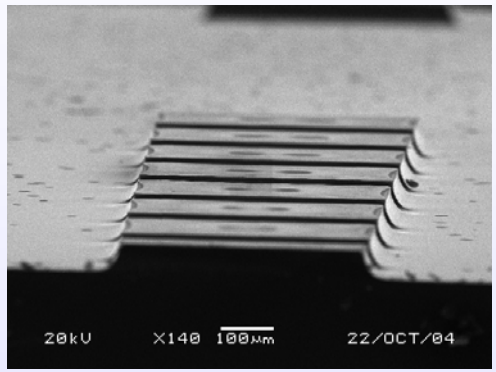
Micro-electrodes interfacing to the implantable electronics on non Silicon substrates.

Some may also include an implanted connector.

# Micro scale electrodes




Processes can provide both high density electrodes and “first level” interconnections.

Electrode tips can be formed in 3D.

Interaction with the biomaterials work package will define electrode shapes for improved electrode–tissue interaction

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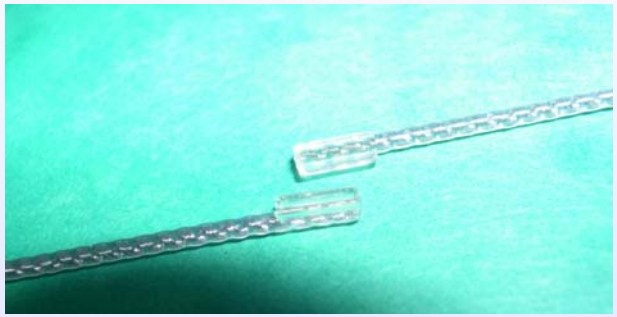
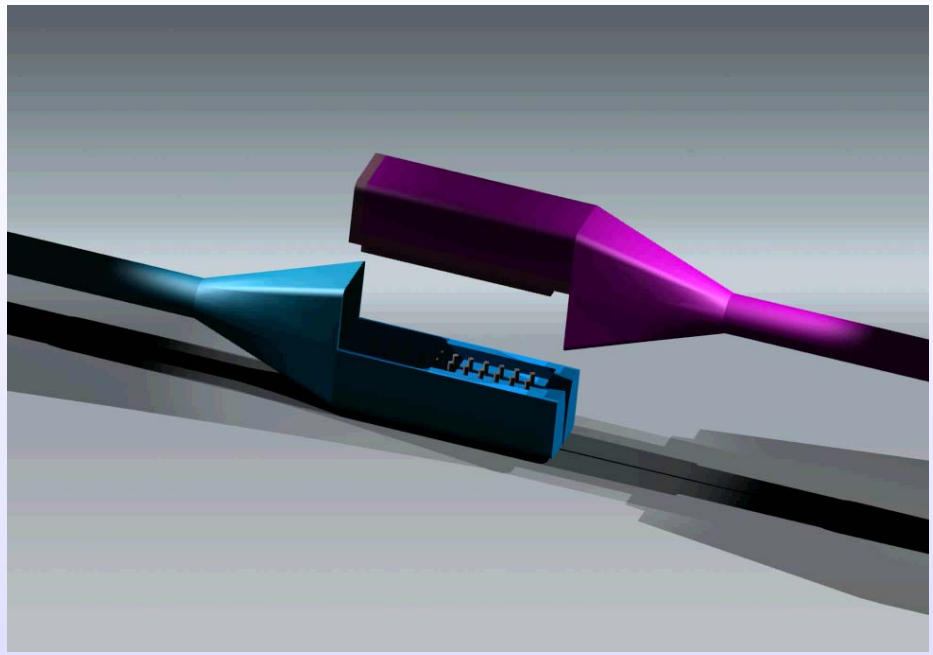
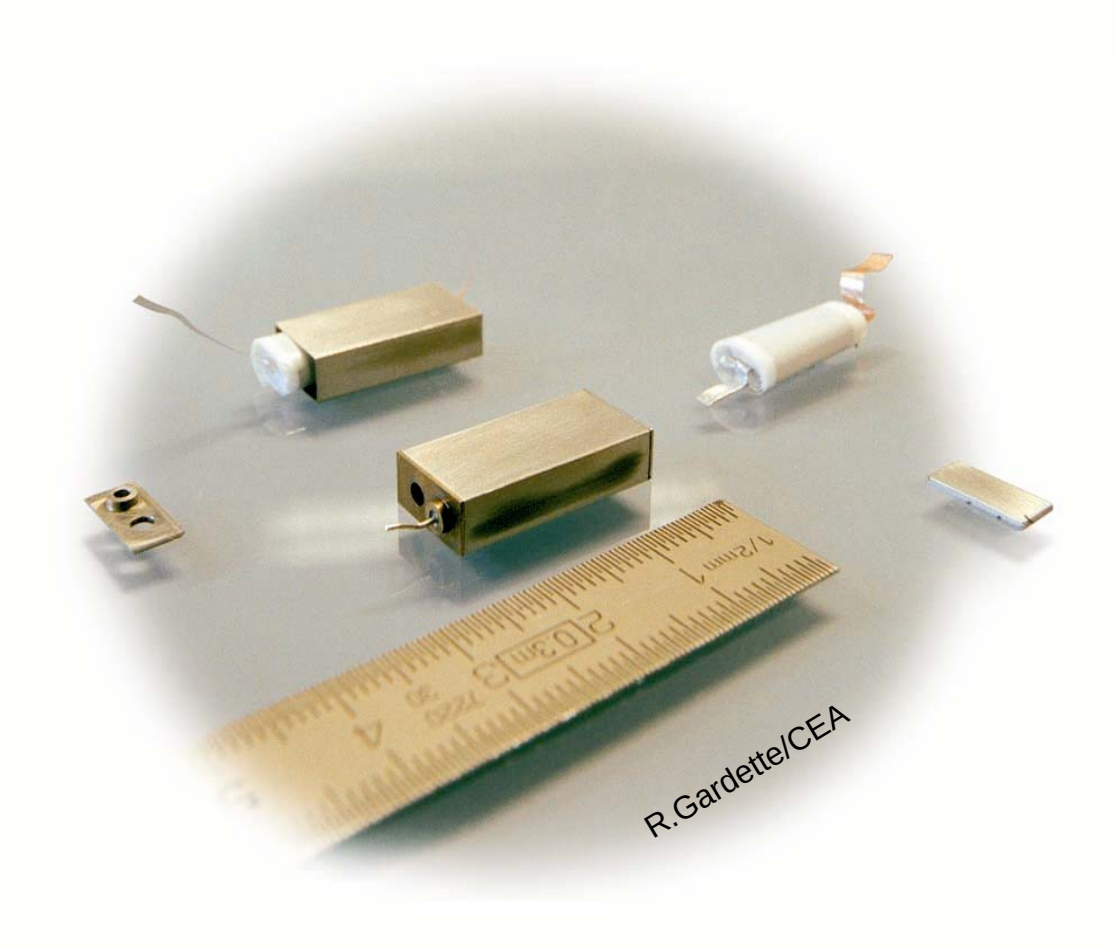




microTEC dummy connector attached to electrode by CTC

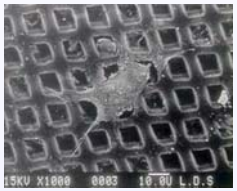
# Battery Cell Design



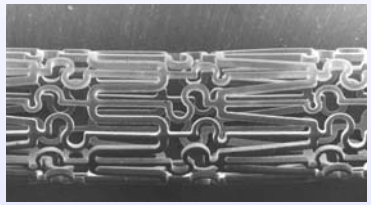
# Assembly, Packaging and encapsulation

- Any medical device incorporating electronics requires:
  - Assembly, where size and shape of the components is critical for the final application
  - Packaging, where the application defines the overall space envelope
  - Encapsulation, where the application defines the level of biocompatibility required. Implants have the most stringent requirements.

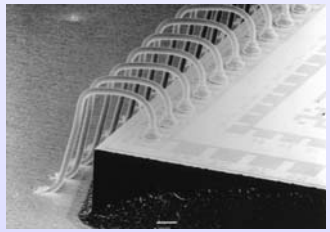
# Assembly & Packaging



## Materials

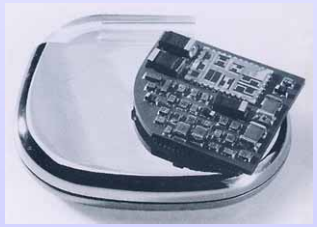


## Micromachining

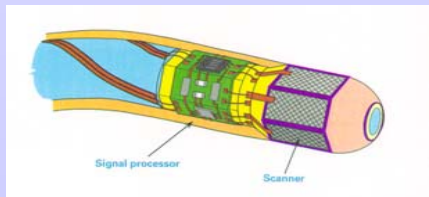


## Interconnect

## Encapsulation and Protection



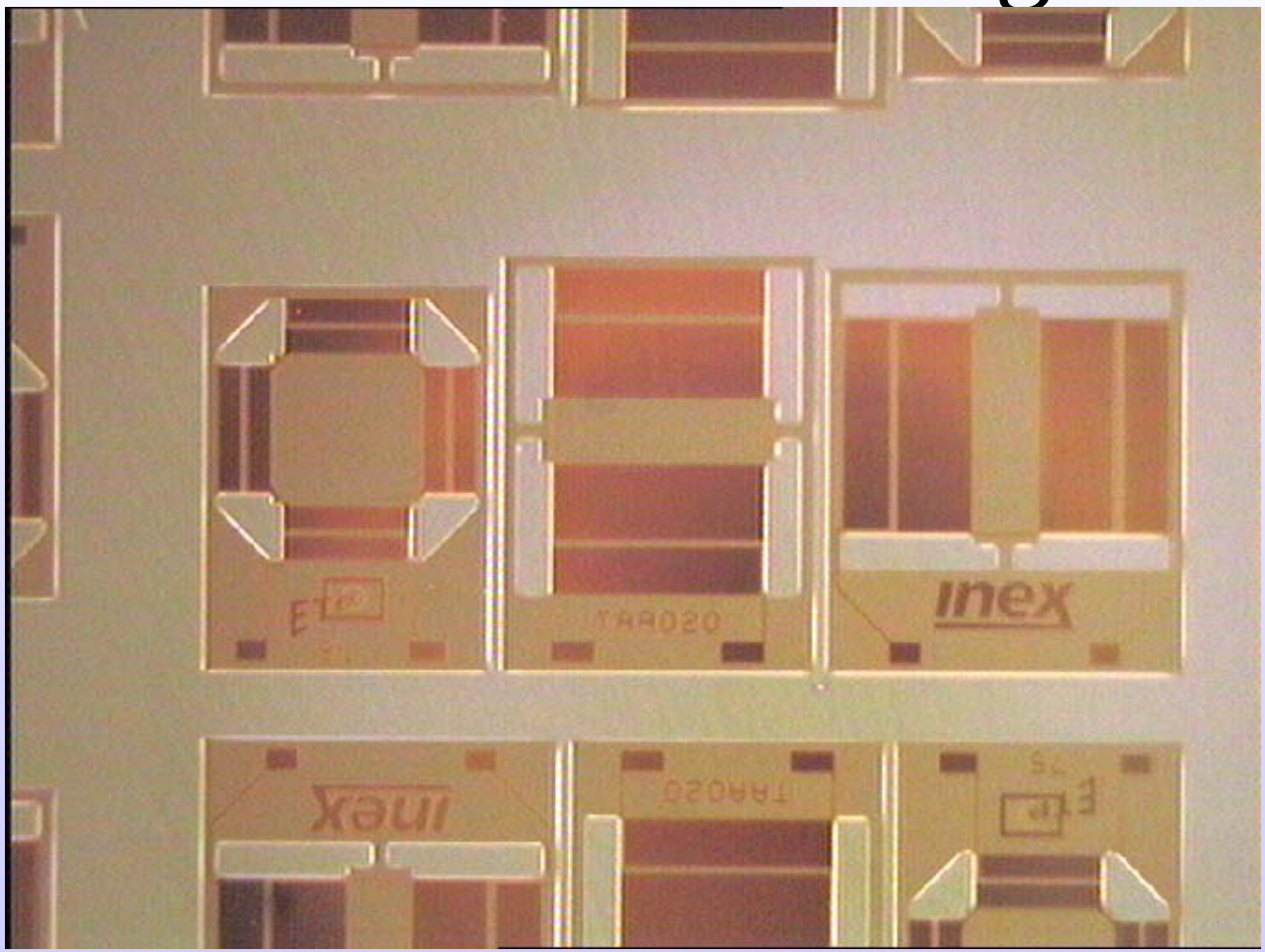
## Assembly and Verification



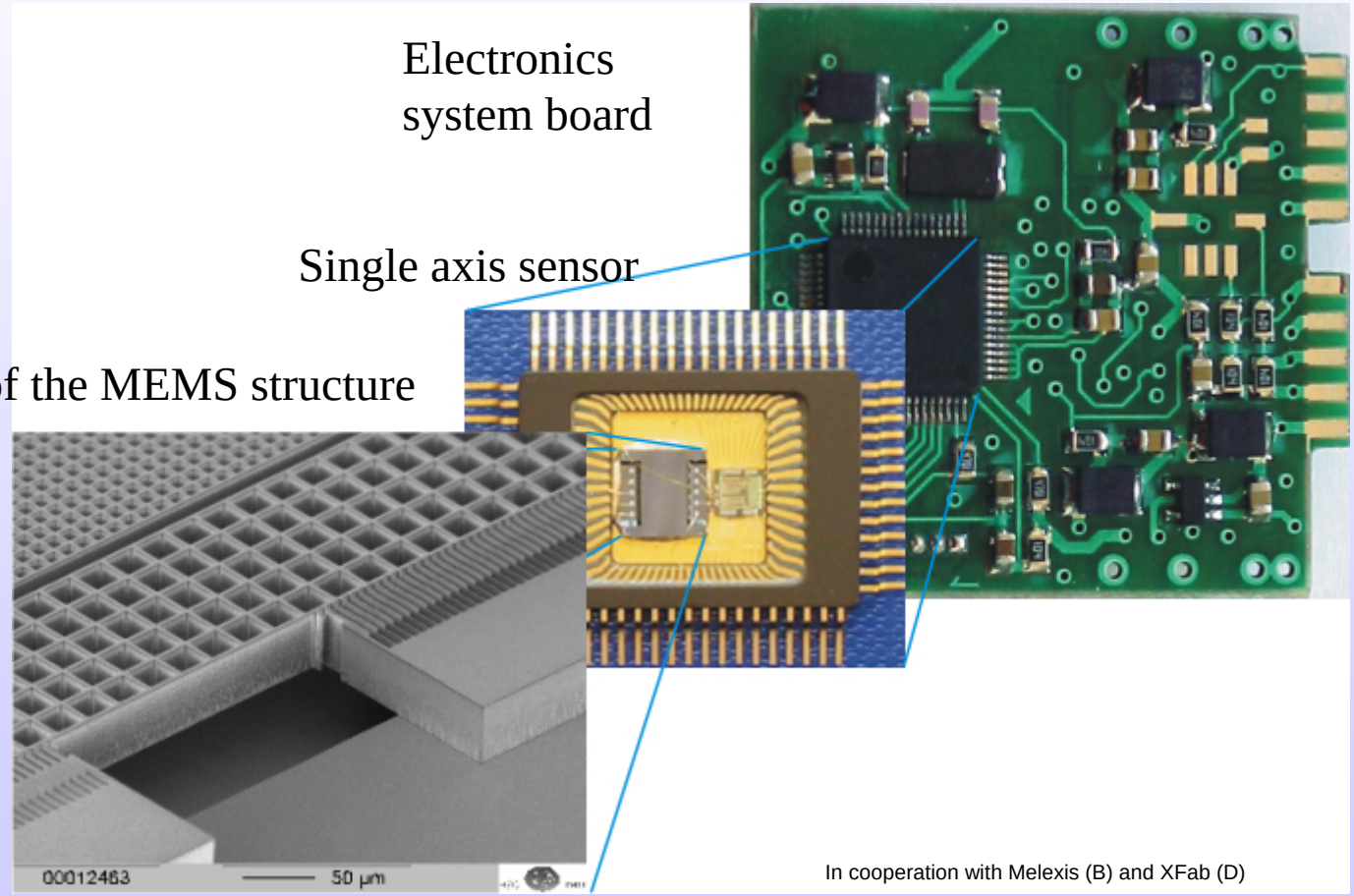
# Sensors for monitoring human body motion

- 3 axis accelerometer and 3 axis gyro for monitoring human body motion.
- Can either be an on the body device or implantable.
- Integration of sensor, electronics, power source and wireless communications required in the final packaged solution.

# Accelerometer Progress



# IMIT 3-axis Gyro Progress



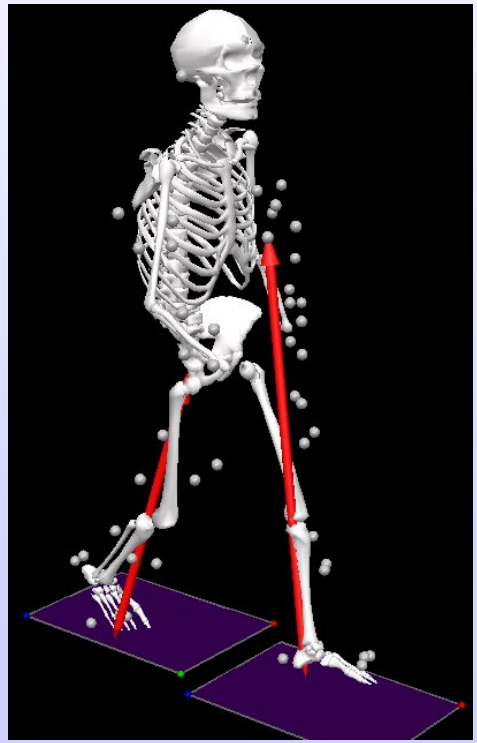
# Human motion analysis progress

- Initial specification for body motion available
- FES focusing on upper limb FES using IMU technologies
  - Salisbury defining set of upper limb tasks
  - Collecting lab-based data for upper limb motion in healthy subjects
  - Developing algorithm to enable the sensor data to be used to trigger the FES implant

# Application of IMU in the project

- The primary application area in HA is in Advanced Functional Stimulation
- All current systems are controlled using basic switches or FSRs, which severely limit their usability
- HA will demonstrate the use of the IMU as the sensor system in the control of an advanced implantable Functional Stimulation System.

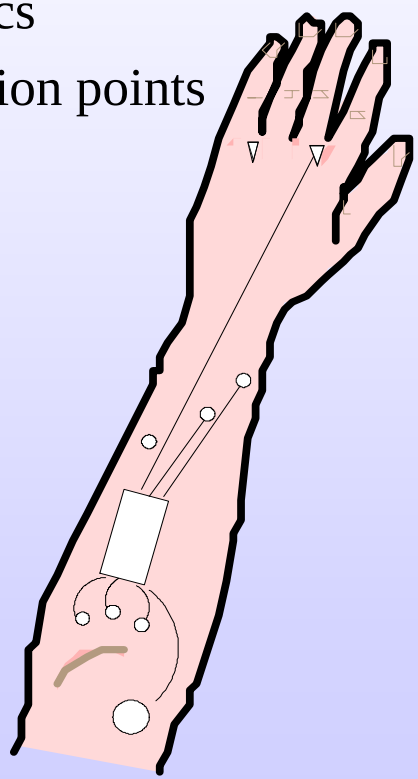
# Human body motion application - determining gait

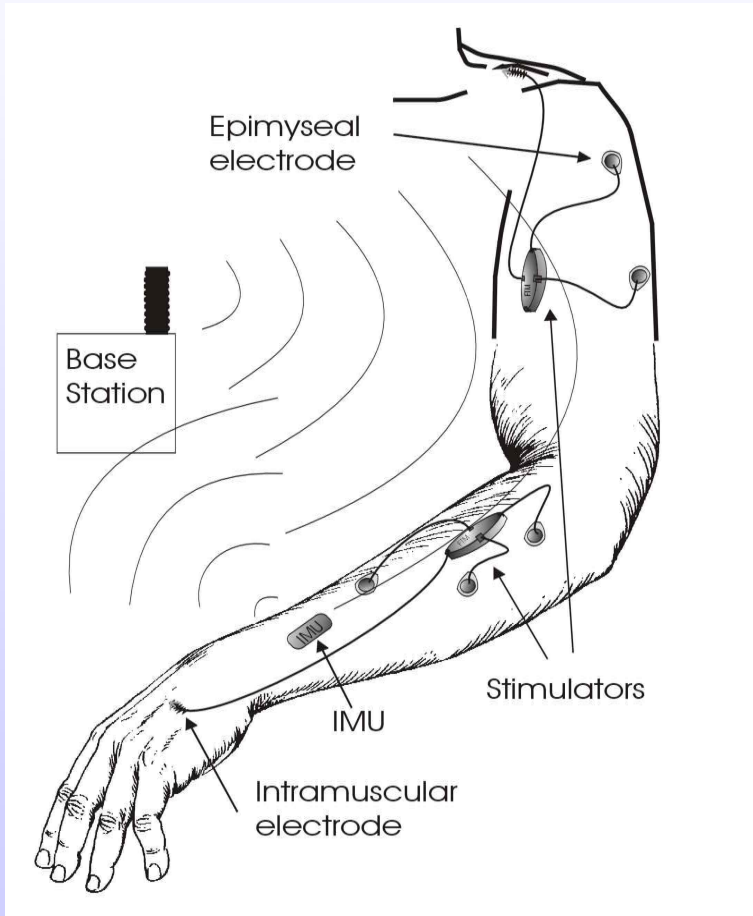


Courtesy of Salford University

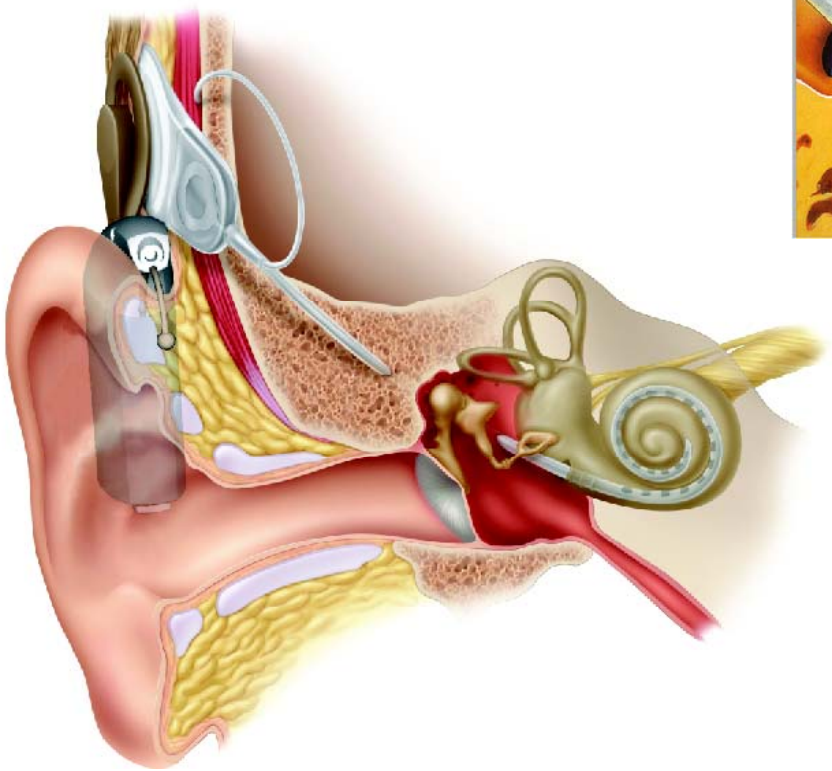
# Upper Limb Implant System

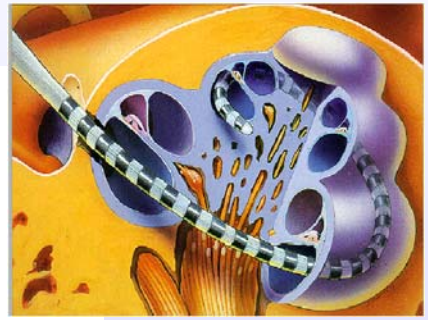
- Mixed monopolar electrodes, common anode
- Active electronics
- Up to 6 stimulation points



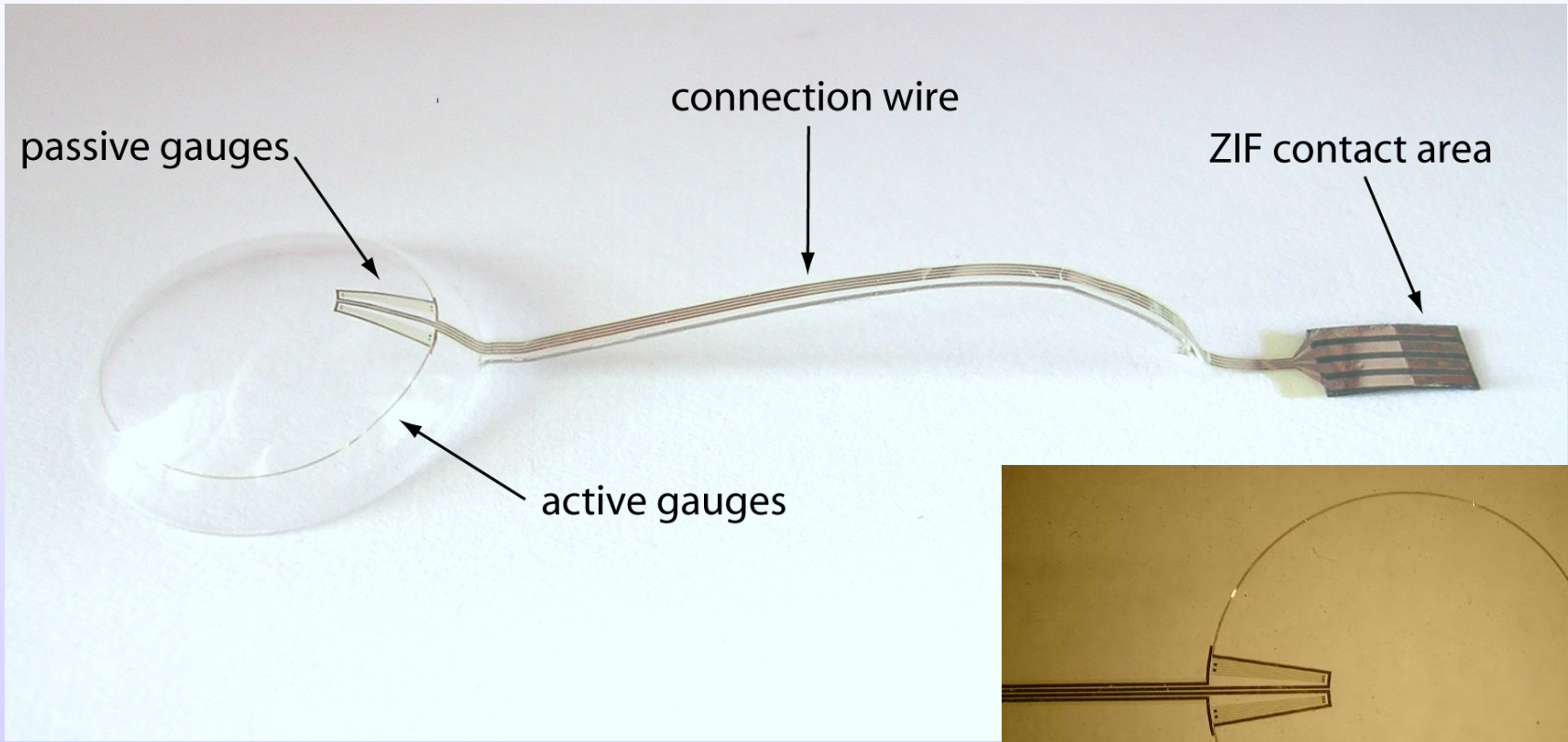


# Cochlear Implant

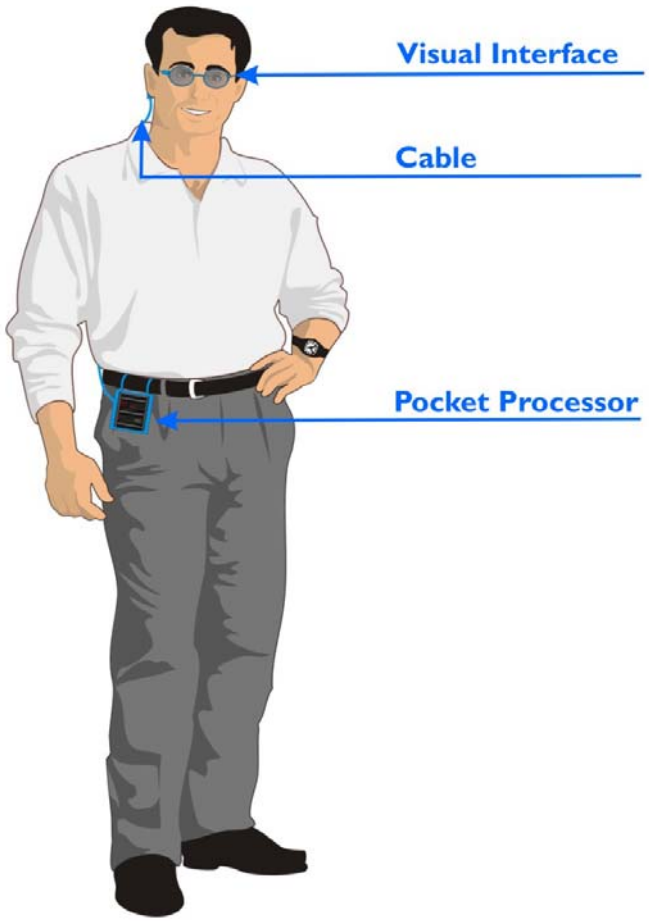




# Glaucoma Sensor - Wired sensor

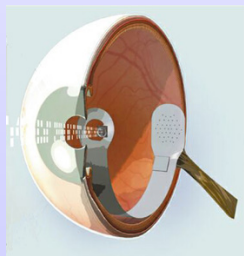


# Our Approach – The Learning Retina Implant




Glasses + Camera Chip (integrated)

Pocket Processor



Retina Implant

Visual Cortex

# Intracranial Pressure Sensor Prototype

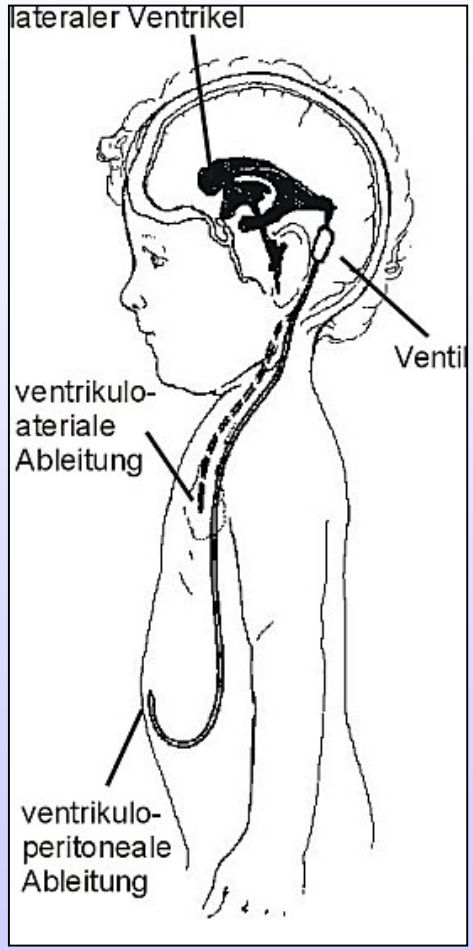
Telemetry unit | Conducting lead | Measuring head

External reader/writer device

# Intracranial Pressure Sensor

## Application: ICP

- Hydrocephalus describes state of excessive accumulation of CSF within the fluid system of the head causing high intracranial pressure
- Therapy: draining CSF from the CNS by shunts
  - Shunt failure
- Approx 40 per 100,000 Individuals have shunts in place
  - 125,000 p.a. in USA




www.motiv-medtech.com

# Exploitation of Medical products

Medical devices manufacturers
Medical Systems suppliers
Medical Approvals bodies
Surgeons and clinical teams from hospitals
Medical Service providers e.g Social Services
Local medical practices
Purchasing teams, e.g NHS in the UK
Medical Insurance groups

# The Healthy Aims Team

- Research Groups in micro and nano technology
- Biomaterials experts
- RF communications experts
- Power sources experts
- Design teams
- Medical Device manufacturers
- Surgeons and clinical teams, including ethics

These all came from the NEXUS Medical Devices USC and includes 6 SMEs from across the EU.

# Summary

- All intelligent medical systems integrate medical electronics with a variety of other technologies.
- Technology development is driven by medical applications.
- Number of technical issues relating specifically to the application, can only be resolved when working closely with clinical experts.
- Commercial aspects needs to be considered from the outset of any new medical product development.
- Examples from the Healthy Aims project detailed on www.healthyaims.org