Main profile “Signal Processing in Medical Applications”
Ilangko Balasingham (Office C347)
Coordinator
Medical Signal Processing Applications

Electronics

Image/signal proc

Communication
Objectives of the profile

– Acquire basic tools to solve important issues related to health and care
  • Fundamentals in advanced signal/image processing,
  • Wireless body area communications
  • Biosensors
– Develop new healthcare technologies and systems for better diagnosis, monitoring and treatment procedures
MELODY 2008 - 2015

Wireless healthcare

WSN Mote
- Wireless UWB
- Relaying nodes in range
- Small and battery operated

Heart rate & breathing sensor
- Medical UWB radar
- Local detection and analysis
- Wireless

Implanted Glucose sensor
- Wireless
- Local analysis
- Controlling insulin pump
- Alarms

Implanted Insulin pump
- Wireless control of injection
- Local drug delivery control
- Smart delivery assessment

Smart chair - smart bed
- Vital signs detection
  - heart rate
- cardiac output
- Blood pressure

WSN <-> WAN bridge
- Data aggregation
- Local proc/interpretation
- Alarms
- Encryption

Ear lobe oximeter
- Blood oxygen saturation
- Body temperature
- Accellerometer
- Wireless WSN using UWB

www.ntnu.no Department of Electronics and Telecommunications, Signal Processing Group
Sensor Network

- Sensor node interface
  - Sensor interfacing
  - Wireless transceiver
  - Local processing filtering data

- Personal gateway
  - Wireless network coordinator
  - Personal information
  - Local database

- Health database
  - Authorized (HL7)
  - Combined
  - Aggregated
  - High quality

Distribute information processing

Short distance network
Medium distance network
Global coverage network
Short range tracking and localization

Topics to be studied

- Wireless sensor network ranging engine based on active echo for in-body/on-body tracking
- Improved sensitivity based on radar principles
- Geometrical triangulation, angle-of-arrival, time difference of arrival, etc. - will derive the Cramér-Rao bounds
Short range sensing

- **Advantages**
  - Non invasiveness, non contact remote and continuous operation
  - Low power, low cost
  - Bio compatibility, user friendliness
  - High specificity and sensitivity

- **Topics to be studied**
  - Remote heartbeat, respiration characterization, blood pressure, cardiac output, etc.
  - Microwave medical imaging of soft tissues (e.g. heart)
  - Appropriate frequencies, use a combination of phased array receivers and SAR techniques, etc.
**4. årskurs**

- **Høst**
  - Perspektivemne (o)
  - TTT 4125 Informasjonsteori (o)
  - TTT 4175 Marin akustikk (o)
  - TTT 4130 Digital kommunikasjon (v)
  - TTK 4160 Medisinsk billeddannelse (v)
  - TMA 4145 Lineære metoder (v)
- **Vår**
  - Ekspert i team (o)
  - TTK 4165 Signalbehandling i medisinsk billeddannelse (o)
  - TTT 4135 Multimedia signabehandling (v)
  - TTT 4200 Radioteknikk intro (v)

*Et ingeniøremne (teknisk emne) fra et annet studieprogram eller studieretning må velges enten i vår- eller høstsemesteret.*
5. årskurs

• **Høst:**
  – **Fordypningsemne (sp 7,5)**
    • Skal velge to temaer med hver med sp 3,75. Skriftlig eksamen i begge temaer. (TTT 29 Biomedisinsk signal- og bildebehandling og kommunikasjon, TTT05 Digital bildekommunikasjon, TTT09 Kommunikasjons- og kodingsteori for trådløse kanaler, TTK10 Signalbehandlingsteknikker i ultralyd billeddannelse, TTK11 Statistisk signalbehandling ved ultralyd billeddannelse, TTT26 Radar, TFE12 Medisinske sensorer, TTT02 Adaptive filtre, TTT07 Fusjonering av sensordata og avanserte radarkonsepter, etc.).
    – **Fordypningsprosjekt (sp 15)**
    – **Ikke tekniske fag (sp 7,5)**
      • MFEL1010 Medisin for ikke-medisiner

• **Vår:**
  – TTT 4950 Masteroppgave (sp 30)
National & International Partners

- Rikshospitalet
- St. Olav hospital
- SINTEF ICT
- Norsk Regnesentral
- University of Oslo
- Novelda AS
- Memscap AS
- ABB Research
- IBM Healthcare
- Atmel AS
- Hospitality AS
- Lifecare AS
- Multihop Com AS
- Telenor AS
- Massachusetts Institute of Technology (MIT), USA
- University of California Berkeley, USA
- University of California Santa Barbara, USA
- Ecole Polytechnique Federale de Lausanne, Switzerland
- National University of Singapore
- National Institute of ICT, Japan
- Imperial College, UK
- Massachusetts Medical Center, USA
- Royal Institute of Technology, Sweden
- Linköping University, Sweden
- Uppsala University, Sweden
- VTT, Finland
- GE Healthcare, UK
- SORIN Group, France
- Medtronic, Holland
- Ericsson AB, Sweden
- Imego AB, Sweden
- Acreo AB, Sweden
Potential Employers

- NTNU (PhD-student)
- Hospitals (Rikshospitalet, St. Olav, Ahus)
- Research centers (SINTEF/NR/FFI)
- Siemens Medical Systems
- GE Healthcare
- Philips Medical Systems
- Medtronic
- MediStim
- SORIN Group
- HP AS
- Ericsson AS
- ABB AS
- IBM Healthcare AS
- Telenor AS
- Imatis AS
- Cisco AS
- Ergo AS
- Novelda AS
- Memscap AS
- EMGS AS
- Accenture
- Ernst & Young
- Many startups