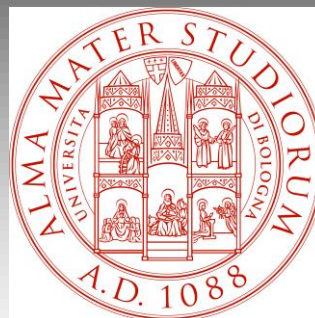




# Alma Mater Studiorum - Università di Bologna

## Biomedical Engineering @DEI

Prof. Lorenzo Chiani, DEI – Dipartimento di Ingegneria dell'Energia Elettrica e dell'Informazione



UNIBO AT A GLANCE

# Education & Internationalization

Founded in **1088**, the University of Bologna has 924 years of history.  
Since 1989, it adopted a **Multicampus Structure**.



## Dimension:

- ~**90.000** students
- 16.000 master+bachelor students per year
- **23** schools (facoltà)
- Libraries: **100**
- Museums: **16**
- Staff: **6.000** teachers and researchers; **3.800** technical-administrative staff

## Internationalization

- 5,000 foreign students from ~100 Countries
- 1.900 incoming exchange students per year
- 1.500 outgoing exchange students per year
- 800 International summer schools students
- 540 Erasmus & 200 Cooperation agreements
- 8 Erasmus Mundus projects on-going

## Enrolled students

Bologna	68 195
Cesena	4 874
Forlì	6 146
Ravenna	3 057
Rimini	5 660
<b>Total</b>	<b>87 932</b>



# Research

Research Units: **96** (of which 69 departments), 13,000 Research Products/Y

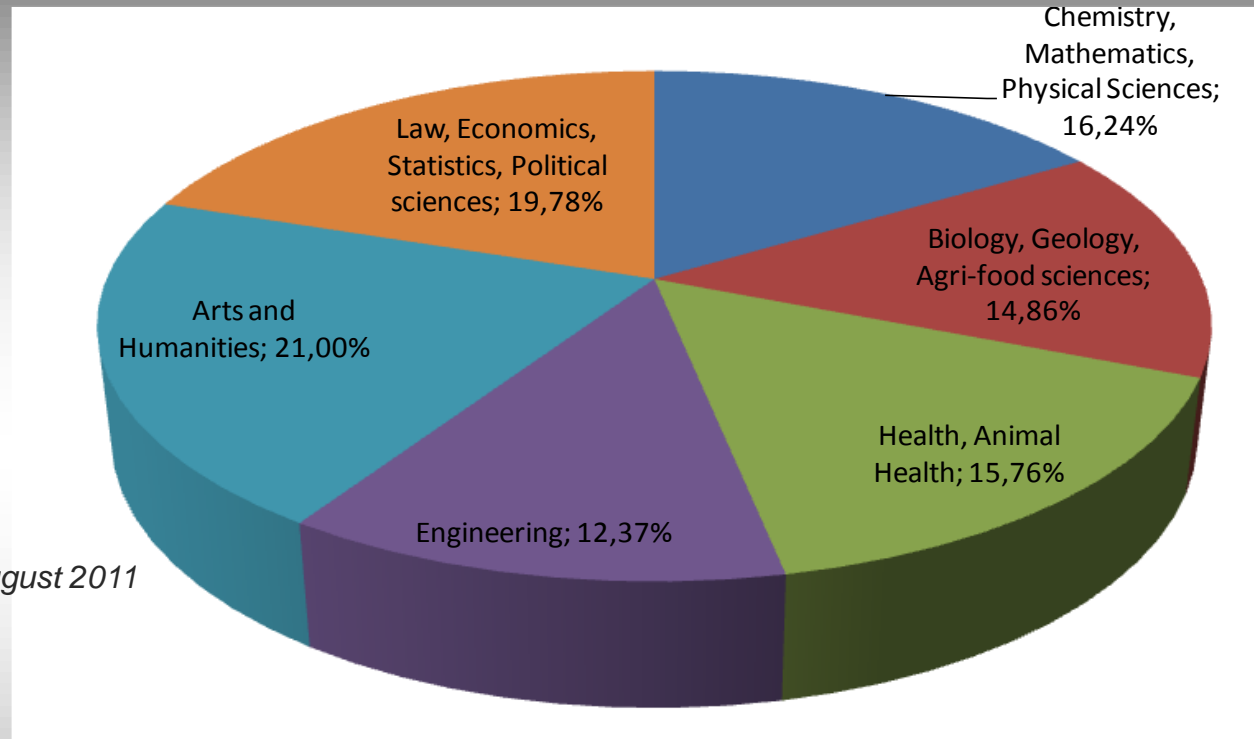
[www.researchranking.org](http://www.researchranking.org)

*1° university in Italy*

*27° university in UE*

*43° all applicants*

*source: Fourth FP7 Monitoring Report, August 2011*



UNIBO participation in FP7:

Total number of FP7 funded projects: **190**, total funding for more than 60 M€ (as of Nov 2011)

UNIBO participation in FP7-ICT:

Total number of FP7-ICT funded projects: ~60, total funding for more than 20M€



# Regional network for industrial research, innovation and technology transfer

## Emilia Romagna (ER): a region of excellence for innovation

ER one of the most advanced regions in EU (eg.: GDP pro-capita, unemployment rate)



## The ER Program: Technopoles

- Spaces
- Industrial Research Centers
- Facilities and equipment
- Research Personnel

A programme for 2010-2013

Fields: the main industrial fields of the region

UNIBOs' leading role in Techno-pole "Life Science & Health Technologies" + "ICT"



# Biomedical engineering GROUP



# Motor & Balance control (by means of wearable systems)

## Motion analysis in neurological disorders

- Parkinson's disease and functional neuro-surgery (DBS)
- Multifactorial evaluation of Parkinson's disease (movement, cognition, neuroanatomy & neurophysiology)
- Neuro-cognitive bases and neural correlates of human movement

Some collaborations:

- Oregon Health and Science University, Portland OR (USA)
- Tel Aviv Sourasky Medical Center (IL)
- KUL Leuven (B)
- ETH Zurich (CH)
- Ospedale Civile di Modena (I)
- Clinica Neurologica, Università di Bologna (I)
- APDM (inertial sensors), Portland, OR (USA)
- Robert Bosch



## Wearable systems

- *Inertial sensors, activity classification and personal health systems, biofeedback*
- *Wearable computing*
- *Smartphone-based movement analysis*
- *Clinical Decision's Support Systems (Evidence Based Medicine)*



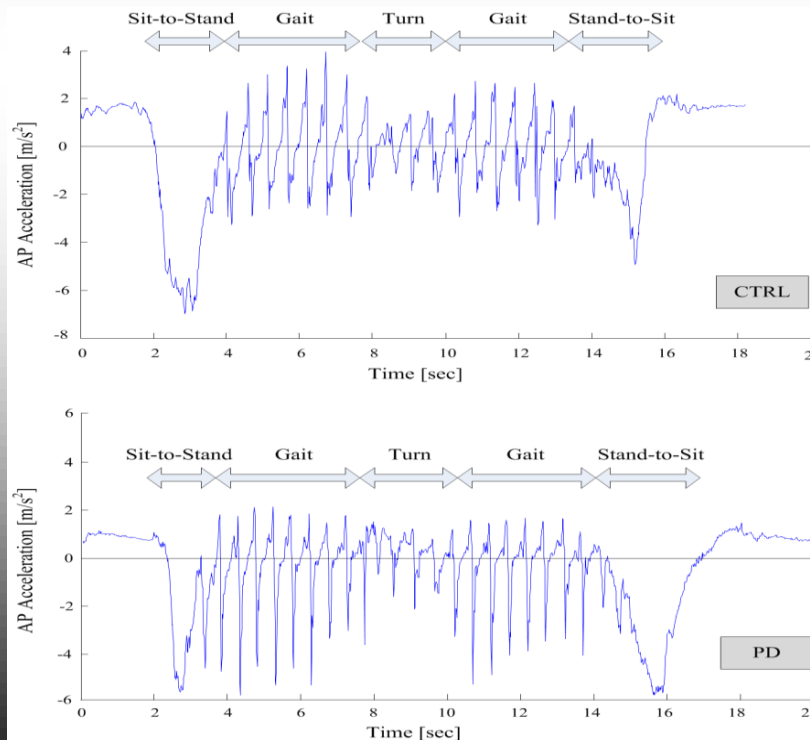
# Biomechanical analysis and 3-D tracking of human movement

## Kinematics and dynamics evaluation

- Accelerometry-based measurement systems
- Sensor fusion algorithms based on Inertial Measurement Unit
- Linear and non-linear calibration of force platforms

## 3-D tracking

- Inertial sensor for:
- Monitoring ADL
- Clinical Scale Instrumentation
- Fall Risk - Fall detection & prediction



## Instrumented Timed Up and Go Test

Our group is providing contribution to the development of **screening tools for the early diagnosis of Parkinson Disease**.

These tools are based on **objective measures** achieved by means of **instrumenting clinical tests** like Timed Up and Go Test.



# Ongoing Projects

- **EU-FP7: “Closed-loop system for personalized and at-home rehabilitation of people with Parkinson's Disease – CuPID”**, Objective ICT-2011.5.1, target a) Personal Health System (PHS) for remote management of disease, treatment and rehabilitation - a2) Rehabilitation of stroke and neurological conditions. Starting: October 2011, 3 years, PI: L. Chiari
- **pERsonal health lab - pERhl**, Regione Emilia Romagna, Italy 2 years, started 2010
- **Wearable instruments for assessing balance and gait disorders**, Italian Ministry for Foreign Affairs (MAE): Strategic Projects, 2011-13
- **EU-FP7: “FAIR Repository for the design of Smart and sELf-adaptive Environments prolonging INdependent living – Fareseeing”**, Starting January 2012, 3 years, PI: L. Chiari

## Previous Projects

- **EU-FP7: “Self Mobility Improvement in the eLderly by CounteractiNG Falls – SMILING”**, ICT 1-7.1 – ICT & Ageing
- **EU-FP6: “Sensing and action to support mobility in Ambient Assisted Living – SENSAction-AAL”**, PRIORITY 2.6.2, INFORMATION SOCIETY TECHNOLOGIES (IST), AMBIENT ASSISTED LIVING (AAL) IN THE AGEING SOCIETY, IST-2006-045622 (coordinatore del progetto)
- **“Cognitive Adaptive Man-Machine Interfaces – CAMMI”**, JTI ARTEMIS: Embedded Computing Systems Initiative - CALL 2008 Subprogramme 8 - Human-Centric Design (HCD) (coordinatore unita locale)



# Knowledge about Real Fall Data

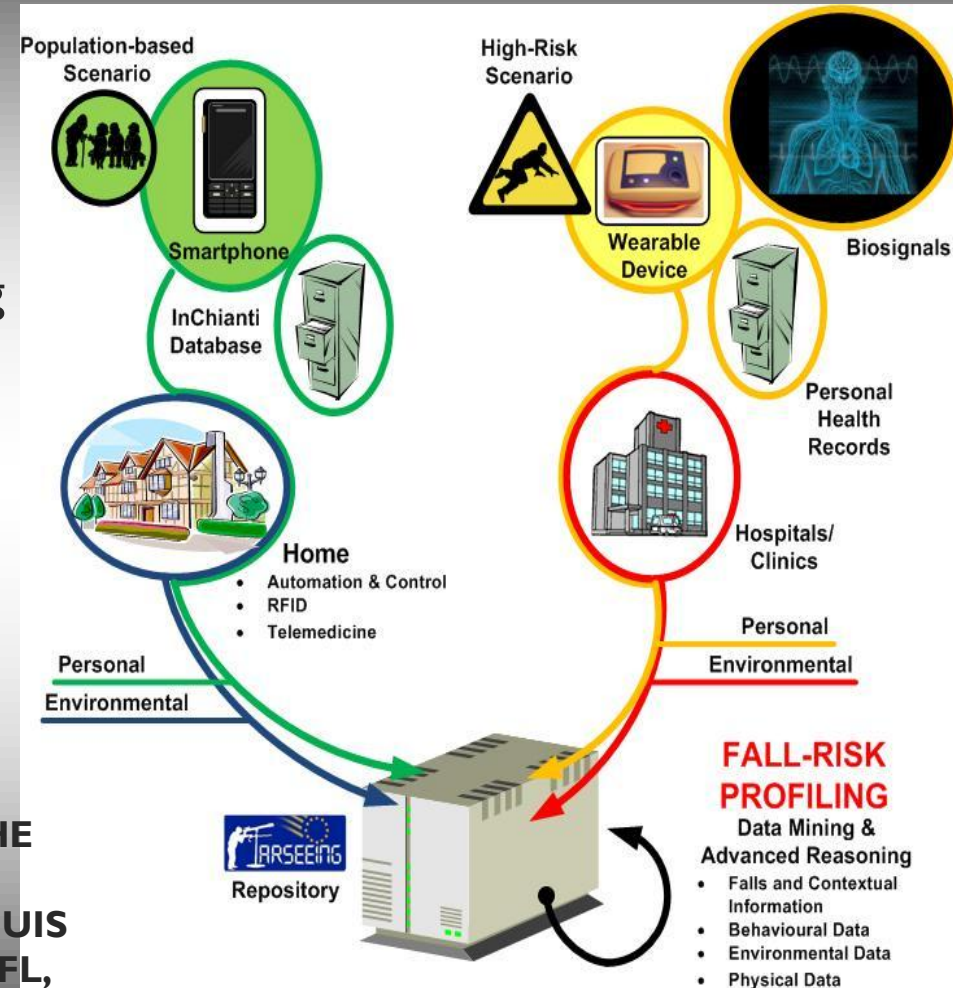


**FARSEEING: FALL Repository for the design of Smart and sElf-adaptive Environments prolonging INdependent livinG (2012-2014)**

**IM:** FARSEEING aims to promote better prediction, prevention and support of older persons, by long-term analysis of behavioral and physiological data collected using smartphones, wearable and environmental sensors: leading to self-adaptive responses.

FARSEEING aims to build the world's largest fall repository.

Partners: **ROBERT BOSCH GESELLSCHAFT FÜR MEDIZINISCHE FORSCHUNG MBH, NOEMALIFE, THE UNIVERSITY OF MANCHESTER, STIFTELSEN SINTEF, ACADEMISCH ZIEKENHUIS ROTTERDAM, BTICINO, AZIENDA SANITARIA DI FIRENZE, EPFL, NORGE TEKNISK-NATURVITENSKAPELIGE UNIVERSITET**



# At home rehabilitation for PD patients

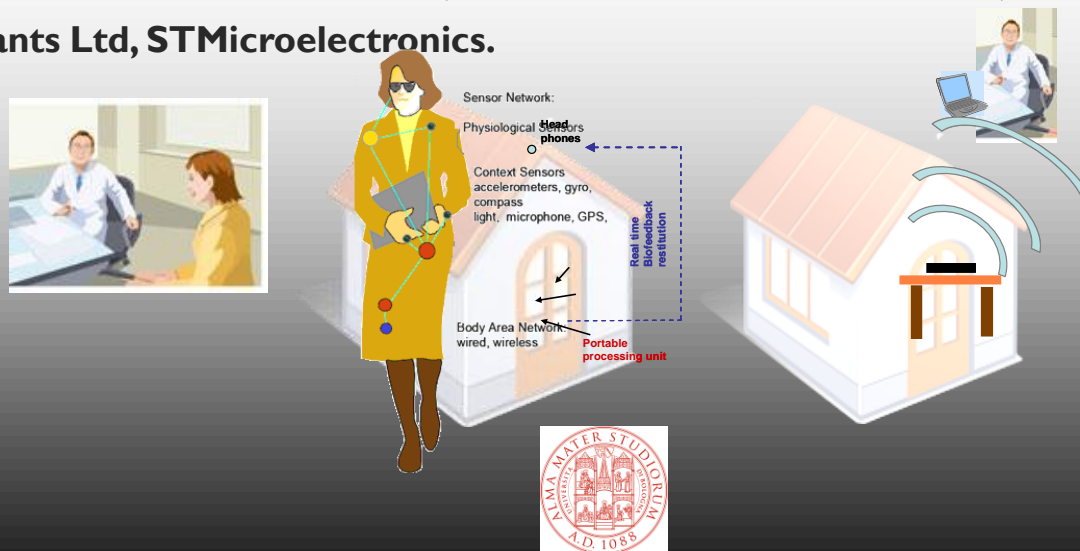


CUPID: Closed-loop system for personalized and at-home rehabilitation of people with Parkinson's Disease (2011-2013)

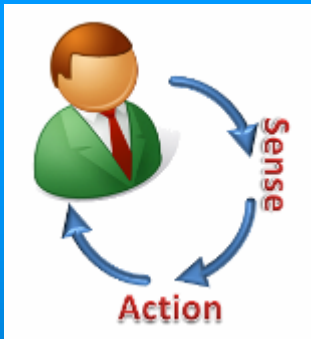
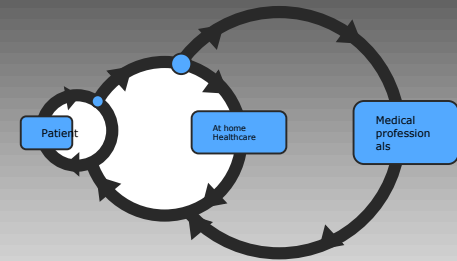
**IM:** In CuPiD we will develop and validate a personal health service, enabling patients with Parkinson's disease to be rehabilitated and treated by at-home training programs, utilizing multisensory information, biofeedback principles, motor learning paradigms.

The service will be based on novel integration of advanced technologies, i.e. wearable non-invasive smart sensors, virtual reality media, and will support remote interaction with clinicians.

Partners: TEL AVIV SOURASKY MEDICAL CENTER, Katholieke Universiteit Leuven, ETH Zurich, EXEL, IBIT, Oxford Computer Consultants Ltd, STMicroelectronics.



# Sensation-AAL: 3 tools in one

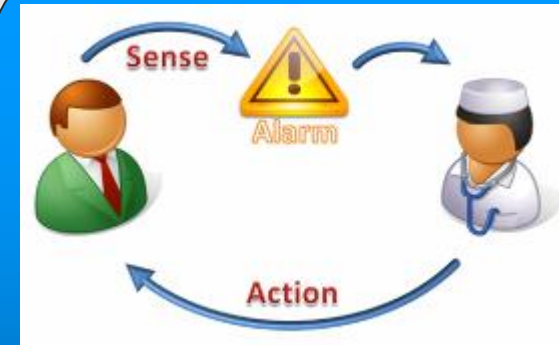
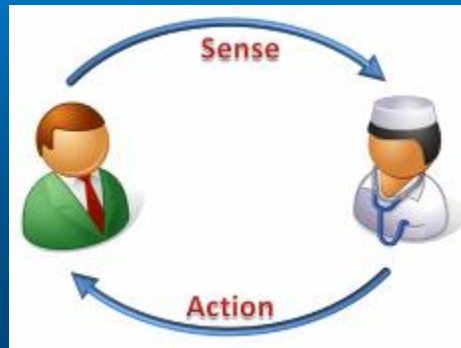


## Local

(e.g. home rehabilitation and training, QoL assessment for user-awareness, short-term, real-time, etc.)

## Remote

(e.g. providing awareness of patient state after treatment to caregivers, long term analysis of behaviour, off-line)



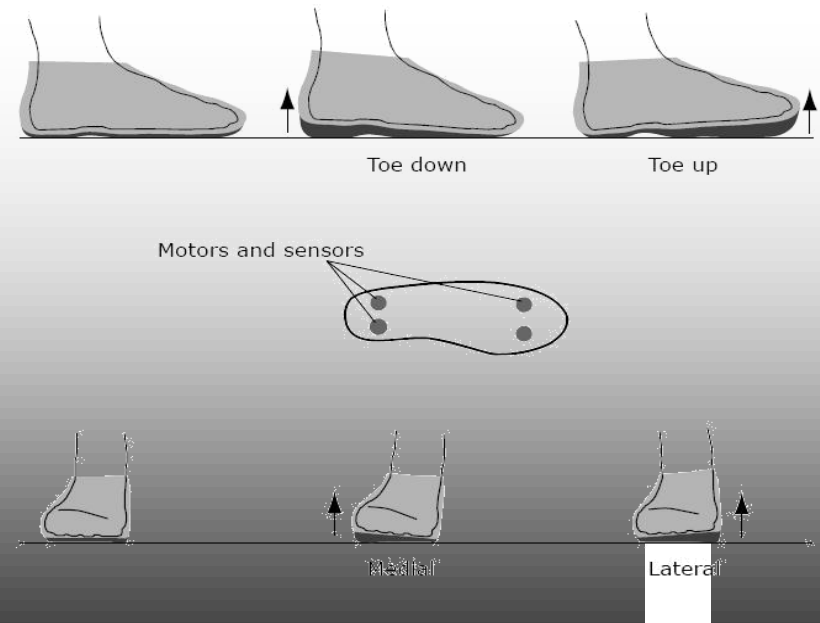
## Local and Remote

(fast reactive detection of dangerous events, alarm dispatching to user and caregivers)

# SMILING & Fall Prevention: a mechatronic training device

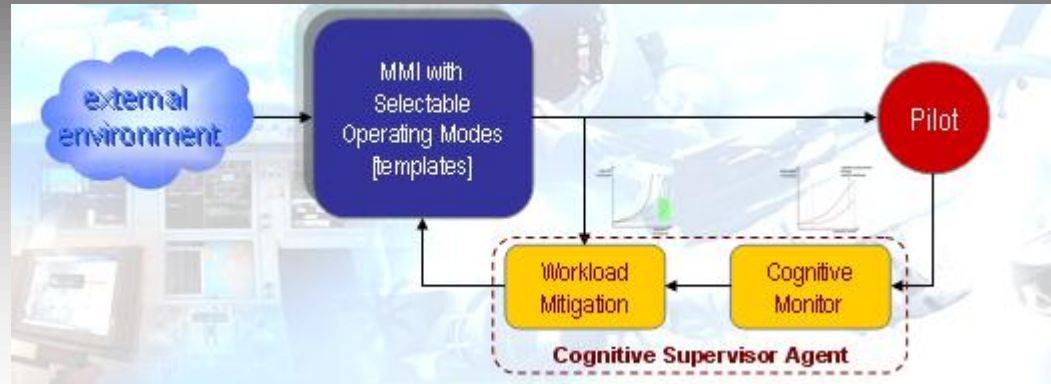
- ⑩ SMILING aimed at enhancing elderly persons capability to avoid falls by re-training patient's walking procedures.
- ⑩ SMILING walking training is based on perturbations of the gait cycle to empower reaction capabilities.

The basic idea: a “shoe” able to change is height and inclination during the swing phase of gait





# Investigate cognitive processes



CAMMI: cognitive adaptive man-machine interface (2009-2011)

**AIM:** To develop closed-loop computational systems, where embedded computing adapts the amount of provided information to the cognitive state of the user/operator (pilot/driver/controller) in order to enable safety and performance improvements trying to establish a joint-cognitive approach into controlling the platform. Assessment of operator's capability will be defined through human cognitive models while system representation will be addressed through augmented reality methodologies to achieve really augmented situational awareness.

**Partners:** SELEX-GALILEO, Fiat Research Center, Magneti Marelli, CNH, THALES, STM, HONEYWELL, TUDelft



# People



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