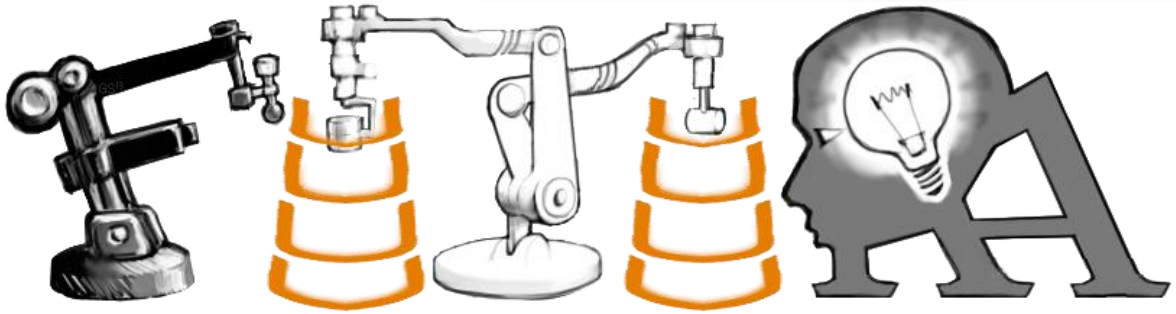


Focused Ultrasound Therapy Using Robotic Approaches

Public Presentation

2014, November

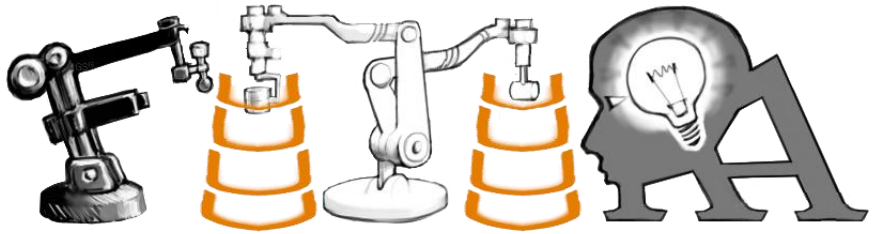
Project ID: 611963

Objective: ICT-2013.2.1 Robotics, Cognitive Systems & Smart Spaces, Symbiotic Interaction

PROJECT COORDINATOR: **ARIANNA MENCIASSI** *(SSSA)*

PROJECT OFFICER: **MICHEL BROCHARD** *(EU Commission)*

FUTURA project at a glance



Project acronym: FUTURA
Project title: Focused Ultrasound Therapy Using Robotic Approaches
Funding scheme: FP7-ICT-Challenge 2
Grant Agreement number: 611963
Start date of project: 01/11/2013
Duration: 36 months
Project web site: www.futuraproject.eu
Project Budget: total cost – 3622659€
EU contribution - 2779866

Project Coordinator: Prof. Arianna Menciassi
Medical Coordinator: Prof. Andreas Melzer

FUTURA Consortium

Partner	Research role/Activity in the Consortium	Main WPs of activity	Expertise
SSSA	**Coordination of the project.** Management activities, definition of technical specifications, obstacles perception, robotic platform registration, robot positioning, robot-patient interfaces	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8, WP9, WP10	Robotics, biomechatronics, system design, biomedical engineering, medical robotics.
UNIVDUN	**Medical coordination .** Medical applications, clinical specifications, FUS, therapy verification, interventional protocol, medical assessment, pre-clinical and clinical studies	WP1, WP2, WP4, WP5, WP8, WP9, WP10	Development of diagnostic and therapeutic Ultrasound devices and applications, US procedures, models and organ mimicking phantoms
IGT	FUS transducer design, 3D-US therapy monitoring and verification, therapy planning	WP1, WP2, WP4, WP5, WP7, WP8, WP9, WP10	Pre-clinical and clinical MRgFUS devices; Acoustic measurements, transducer design, phased array electronics.
CAMELOT	Machine learning, automation of therapy planning and monitoring, multimodal image fusion	WP1, WP2, WP4, WP5, WP6, WP8, WP10	Machine Learning, Medical Image Analysis, High-Performance Computing; Lean Software and GUI Development.
SM	Robotic manipulators design, collision avoidance between robotic manipulators, obstacles perception and avoidance, safety strategy, validation of safety standards and procedures	WP1, WP2, WP3, WP4, WP5, WP7, WP8, WP10	Robotics; Mechatronics; System design, control and automation; Mechanical, electronic, biomedical and software Engineering.
IBSmm	System integration and benchmarking with existing solution, safety regulatory	WP1, WP2, WP7, WP8, WP9, WP10	Embedded electronics design; Medical Imaging; Image guided surgery; Medical devices engineering; DICOM implementation; Regulatory

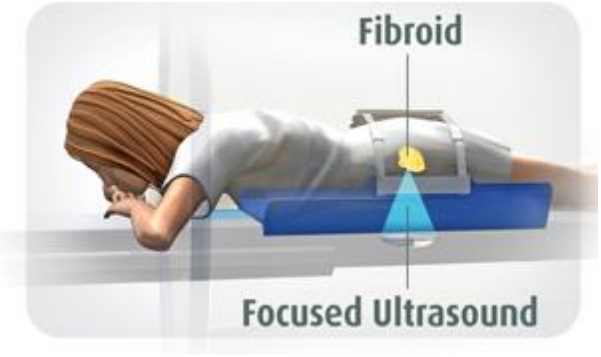
SSSA and UNIVDUN: University

CAMELOT, SM, IBSmm: SMEs

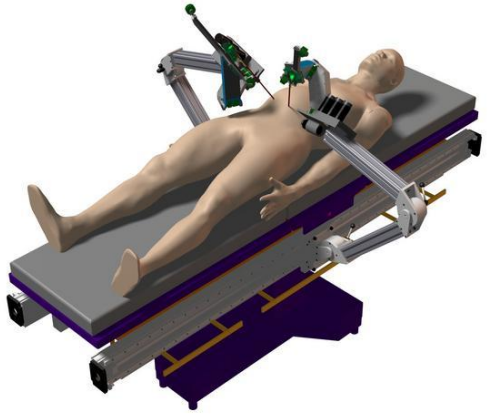
Focused Ultrasound Therapy Using Robotic Approaches - FUTURA

FUS

ROBOTICS



FUTURA



Focused Ultrasound Surgery: clinically approved machines

MRgFUS

ExAblate, Insightec, Israel

Sonaleeve, Philips, USA

Sonablate-500, Focus Surgery, USA

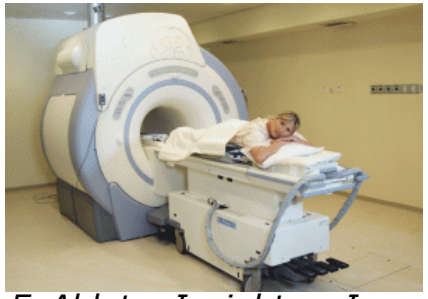
Model-JC, Chongqing HAIFU™, China

USgFUS

Focused Ultrasound Surgery (FUS)

MRgFUS

- Advantages
  - High soft tissue contrast
  - Good for planning
    - ✓ Clear 3D images
    - ✓ High sensitivity for tumor detection
  - Thermometry
    - ✓ Confirm targeting with sublethal heating
    - ✓ Follow lethal exposures to measure response
- Disadvantages
  - High cost
  - Labor intensive
  - Slow imaging



ExAblate, Insightec, Israel

Sonaleeve, Philips, USA

USgFUS

- Advantages
  - Low cost
  - Real time
  - High resolution
  - Verify the acoustic window
- Disadvantages
  - (Usually) only 2D
  - Images are harder to interpret
  - Temperature monitoring not yet available
  - Gas bubbles and coagulated tissue distort the images

Sonablate-500, Focus Surgery, USA

Model-JC, Chongqing HAIFU™, China

FUTURA expected outcomes

The goal of FUTURA project is to design, develop and assess an **innovative robotic platform** with **cognitive capabilities** for the delivery of non-invasive therapy by means of **High Intensity Focused Ultrasounds,** under **Ultrasounds guidance.**

Merging surgical robotics and non-invasive ultrasound therapy to advance:

- **Robustness**, **accuracy**, **precision, flexibility** and **reliability** of therapy

Calibration procedure: **ACCURACY** lower than about **1mm** in position and **0.5°** in orientation

Final targeting **ACCURACY** will be guaranteed **within** the **HIFU focal spot** volumetric dimensions (i.e. a cylindrical shape of about **1.5mmx7mm**)

- Widespread **diffusion of FUS** into routine clinical applications (starting from specific clinical targets)
- **Safety** and **acceptability** of the robotic platform into the surgical rooms

FUTURA objectives from Annex I

- The goal of FUTURA is to design, develop and assess an innovative **robotic platform** for the delivery of **non-invasive therapy** by means of **High Intensity Focused Ultrasounds**.
- The expected contribution is to advance **robustness, accuracy, precision and reliability of the therapy**, as well as improving **safety and acceptability of multifunctional robotic platforms** in the surgical room.
  - ***Objective 1:*** *Merging surgical robotics, non-invasive ultrasound therapy and machine learning for medical imaging.*
  - ***Objective 2:*** *Development of a multifunctional robotic surgical platform able to perform different tasks and which possesses cognitive capabilities such as collision avoidance and obstacle perception.*
  - ***Objective 3:*** *Improvement of planning and monitoring of Ultrasound therapy.*
  - ***Objective 4:*** *Improvement of therapy delivery.*

FUTURA Platform: overview

Therapeutic module

HIFU transducer for delivering therapy.

Monitoring module

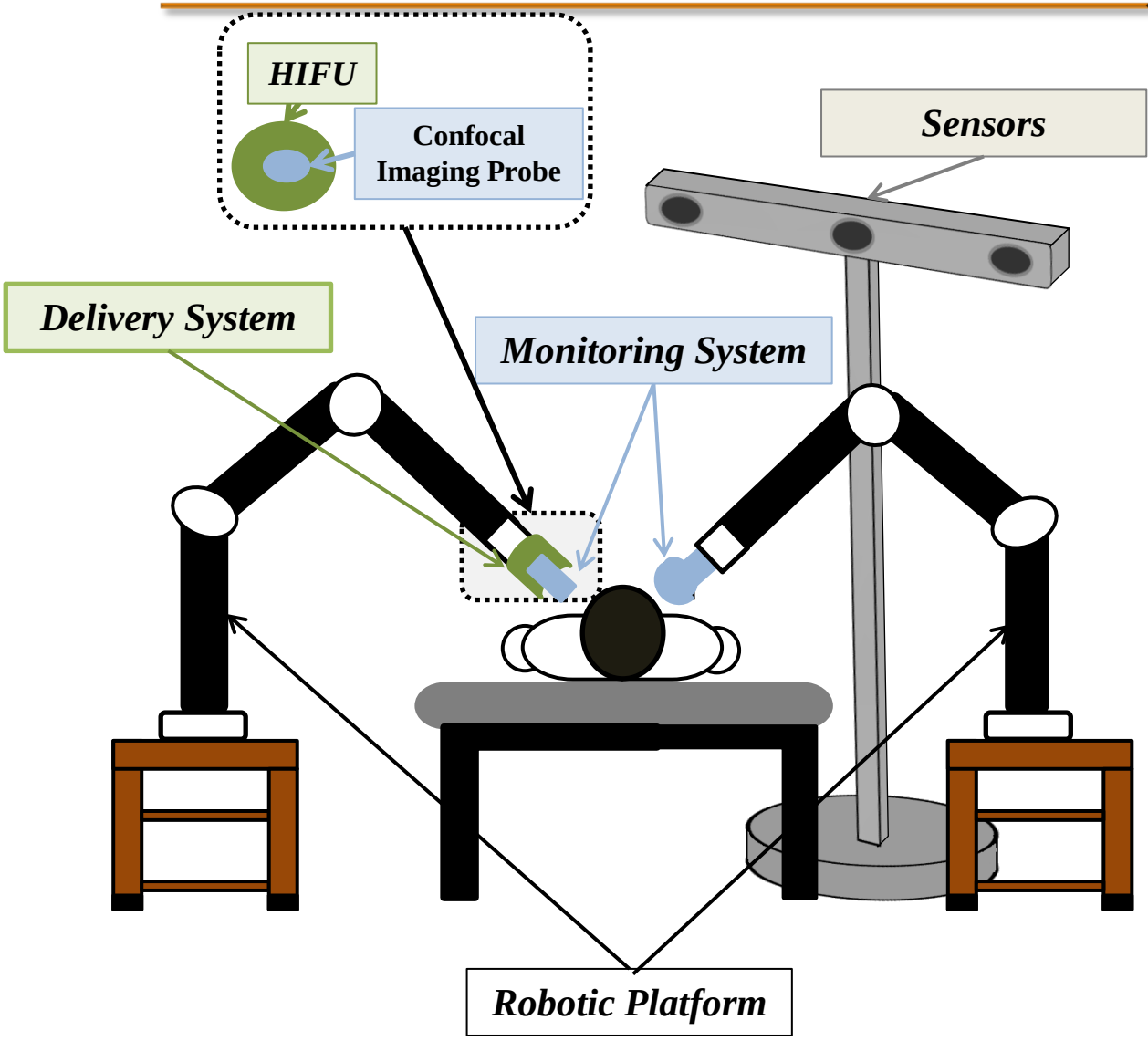
1 2D US probe confocal to the HIFU transducer for monitor therapy and 1 3D US probe mounted on the second robotic arm to guarantee a continuous adjustment of robots position.

Sensor module

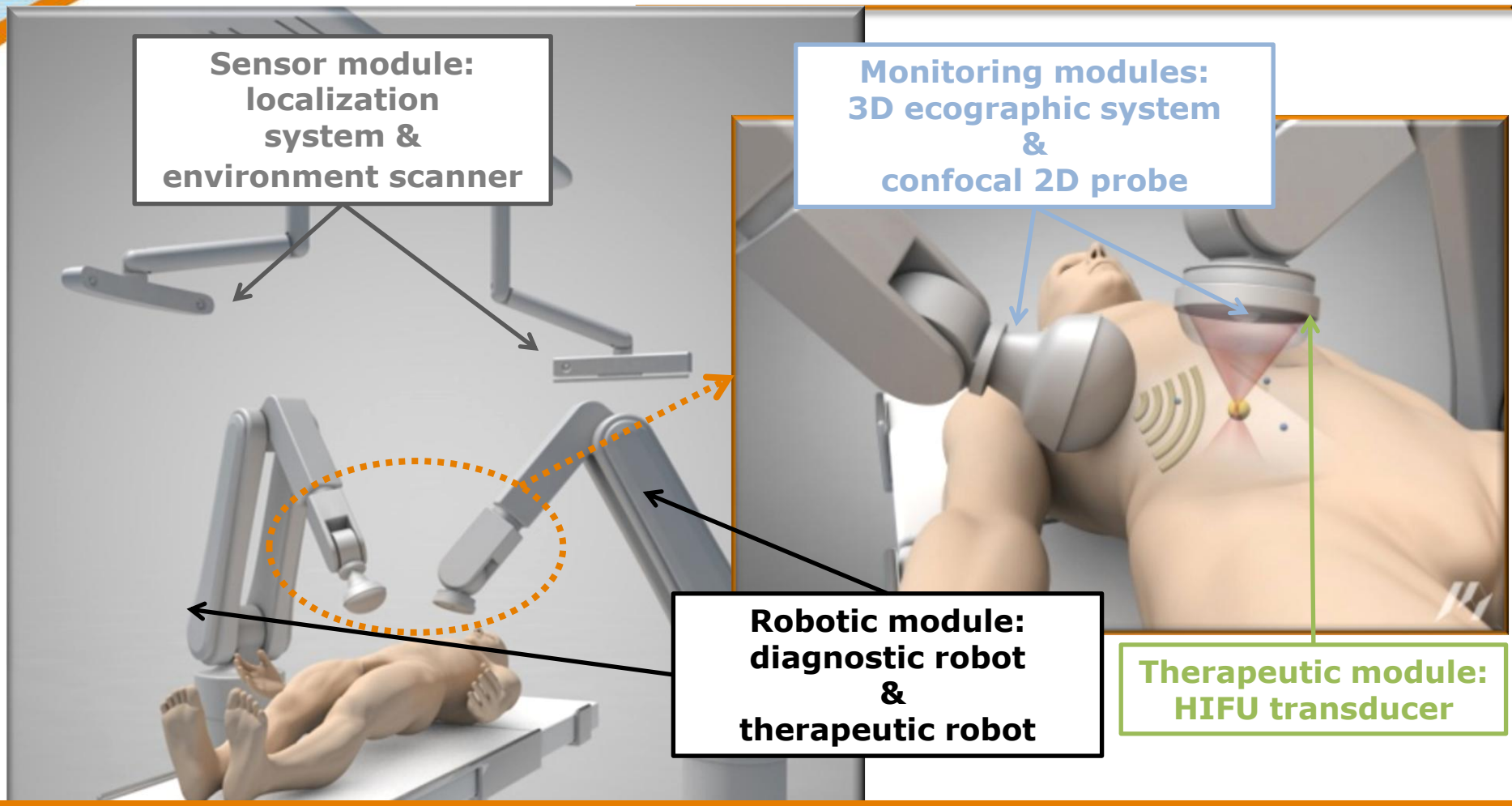
Proprioceptive and exteroceptive sensors for the implementation of dedicated control strategies, platform registration, monitoring robot-patient interactions and environment control.

Robotic module

2 serial manipulators matching technical and medical specifications.



FUTURA Platform: Main features



In order to combine non-invasive features (US+HIFU) with accuracy, FUTURA focuses on:

- ❑ Multimodal reconstruction aspects
- ❑ Sensors fusion algorithms and safety strategies
- ❑ Machine learning implementations

FUTURA Contacts

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