Dipartimento Integrato Interistituzionale
DIPINT

Primo Workshop

Clinical Research and Innovation

Venerdì 4 luglio 2014 9.00 - 19.00

Aula Magna - Polo Fibonacci - Largo Pontecorvo 3, Pisa

Image guided treatments and simulation

Dott. Armando Cuttano , ***Vincenzo Ferrari Phd***

CENTRO DI FORMAZIONE E SIMULAZIONE NEONATALE

ENDOCAS
CENTER FOR COMPUTER ASSISTED SURGERY

REGIONE TOSCANA

DISTRETTO TOSCANO SCIENZE DELLA VITA

COMUNE DI PISA

EndoCAS – University of Pisa

- Director Prof. Mauro Ferrari
- Coordinator Eng. Vincenzo Ferrari, Phd
- The Research team involves: 13 Engineers, Surgeons (& other Clinicians), Radiologists, Residents, Economists

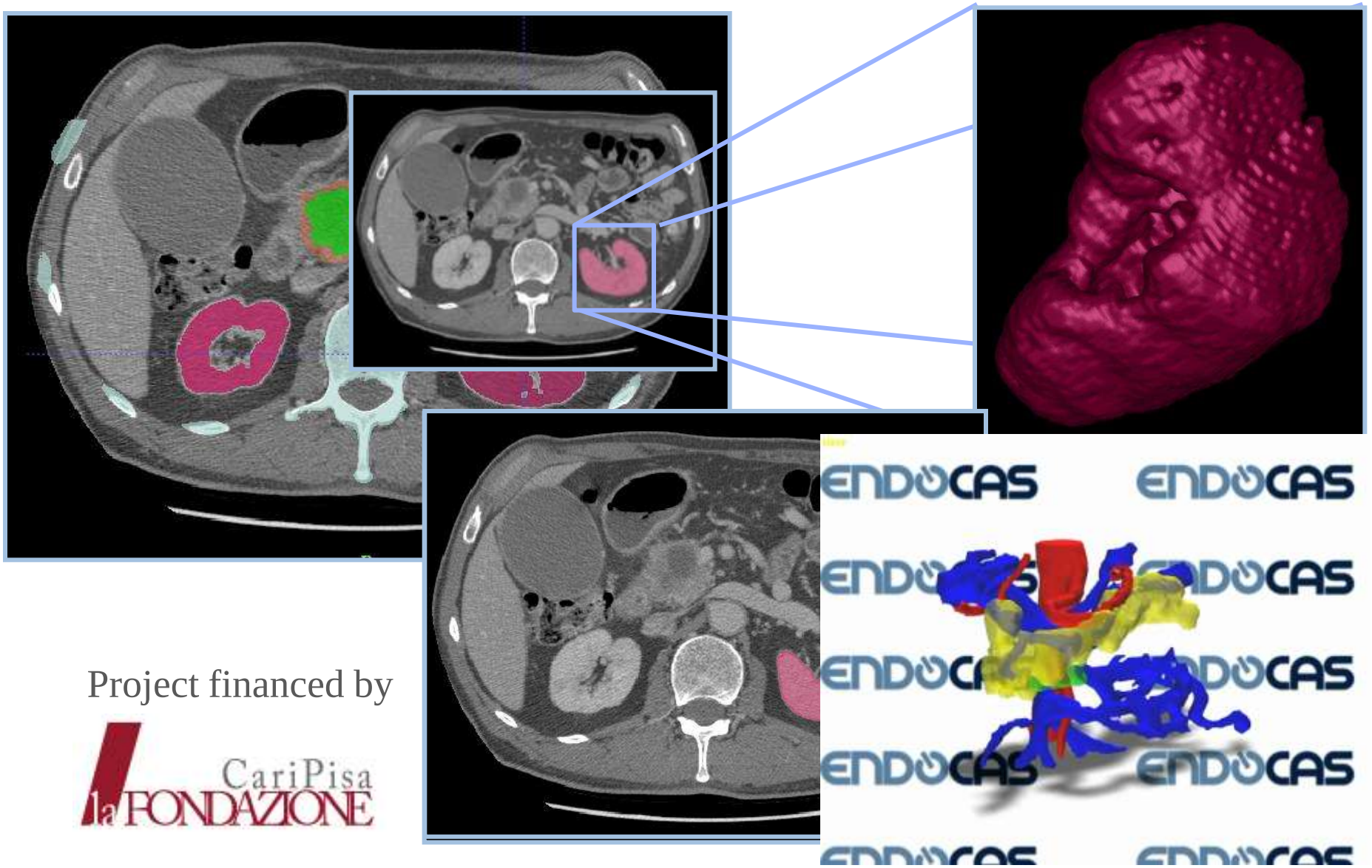
Main Research Areas

The mission of EndoCAS is to develop breakthrough technologies based on engineering and information technologies **to improve the current medical procedures and reduce their invasiveness by means of an optimal use of medical imaging**.

The main research areas are:

Planning **Navigation** **Simulation**

Segmentation pipeline for surgical planning



Project financed by

CariPisa
la FONDAZIONE

Planning for general surgery...

NCBI Resources How To

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Surg Endosc. 2011 Sep 23. [Epub ahead of print]

Value of multidetector computed tomography image segmentation for preoperative planning in general surgery.

Ferrari V, Carbone M, Cappelli C, Boni L, Melfi F, Ferrari M, Mosca F, Pietrabissa A

EndoCAS Center, Università di Pisa, Edificio 102, Ospedale di Cisanello, Via Paradisa 2, 56124, Pisa, Italy, vincenzo.ferrari@endocas.org

Abstract

BACKGROUND: Using practical examples, this report aims to highlight the clinical value of patient-specific three-dimensional (3D) models obtained segmenting multidetector computed tomography (MDCT) images, for preoperative planning in general surgery.

METHODS: In this study, segmentation and 3D model generation were performed using a semiautomatic tool developed in the authors' laboratory. Their segmentation procedure is based on the neighborhood connected region-growing algorithm that, appropriately parameterized for the anatomy of interest and combined with the optimal segmentation sequence, generates good-quality 3D images coupled with usability of use. Using a touch screen monitor, manual refining can be added to segment structures unsuitable for automatic reconstruction. Three-dimensional models of 10 candidates for major general surgery procedures were presented to the operating surgeons for evaluation. A questionnaire then was administered after surgery to assess the perceived added value of the new technology.

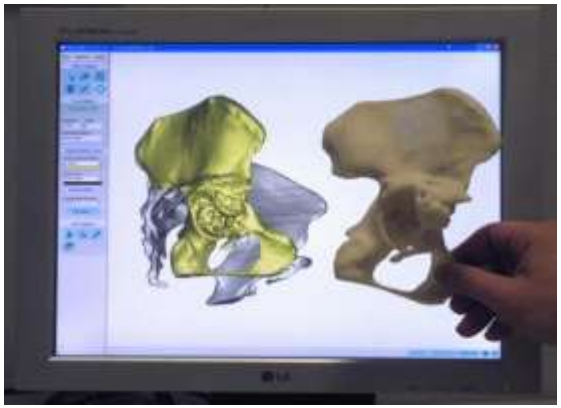
RESULTS: The questionnaire results were very positive. The authors recorded the diffuse opinion that planning the procedure using a segmented data set allows the surgeon to plan critical interventions with better awareness of the specific patient anatomy and consequently facilitates choosing the best surgical approach.

CONCLUSIONS: The benefit shown in this report supports a wider use of segmentation software in clinical practice, even taking into account the extra time and effort required to learn and use these

PMID: 21947742 [PubMed - as supplied by publisher]

LinkOut - more resources

… for orthopaedics, gynecology, plastic surgery…



Surg Technol Int. 2013 Sep;23:228-34.

Computer tomography prototyping and virtual procedure simulation in difficult cases of hip replacement surgery.

Parchi PD[1], Ferrari V[2], Piolanti N[1], Andreani L[1], Condino S[2], Evangelisti G[1], Lisanti M[3].

Abdom Imaging. 2012 Apr 4. [Epub ahead of print]

Anatomical localization of deep infiltrating endometriosis: 3D MRI reconstructions.

Giusti S, Forasassi F, Bastiani L, Cela V, Pluchino N, Ferrari V, Fruzzetti E, Caramella D, Bartolozzi C.

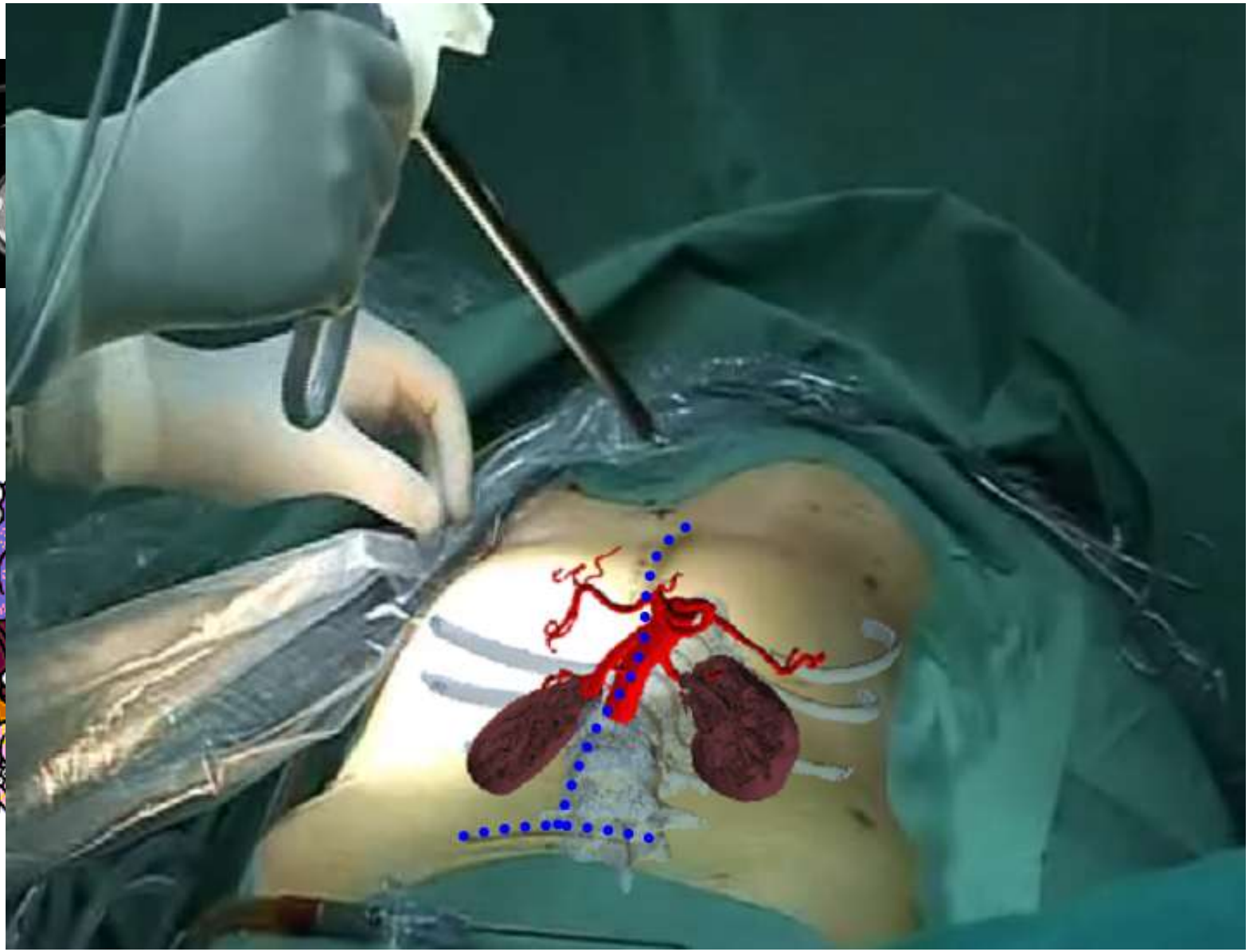
Department of Radiology, University of Pisa, Pisa, Italy, s.giusti@med.unipi.it.

Patient-Specific 3D Surgical Planning To Perform Cutting Edge Robotic Surgery

Carbone M.[1], Cappelli C.[2], Ferrari V. [1], Signori S. [3], De Lio N. [3], Perrone V. [3], Mosca F.1, Boggi U.[3]

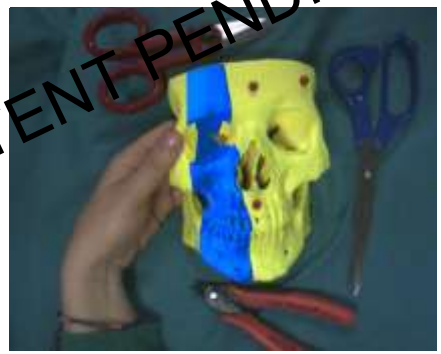
[1]EndoCAS – University Hospital of Pisa,

Image Guided Surgery



Wearable Augmented Reality for Medicine

PATENT PENDING



IEEE Trans Biomed Eng. 2009 Nov;56(11):2627-33. doi: 10.1109/TBME.2009.2028013. Epub 2009 Jul 31.

A 3-D mixed-reality system for stereoscopic visualization of medical dataset.

Ferrari V[1], Megali G, Troia E, Pietrabissa A, Mosca F.

Opera

L'innovazione per la salute

Regione Toscana

Le ali alle tue idee

Il Progetto OPERA è realizzato con il determinante contributo della Regione Toscana a valere sul Programma Operativo Regionale cofinanziato dal FESR per l'obiettivo "Competitività regionale e occupazione" anni 2007-2013.

PATENTED SOLUTION

The International Journal of **Medical Robotics** and **Computer Assisted Surgery**

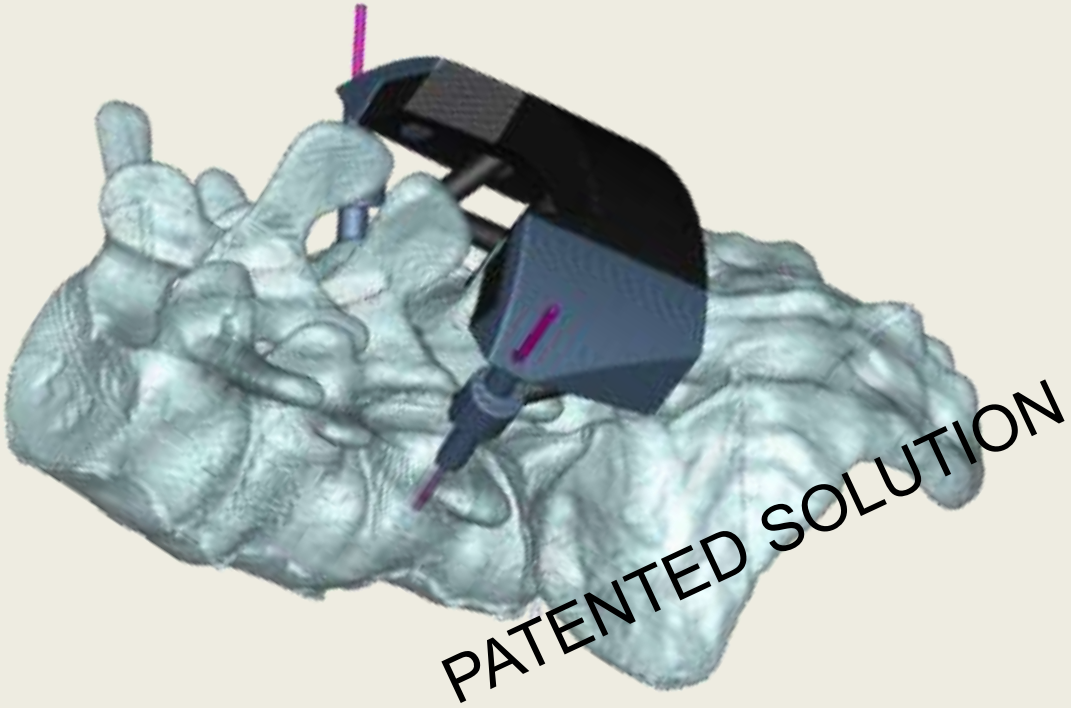
THE INTERNATIONAL JOURNAL OF MEDICAL ROBOTICS AND COMPUTER ASSISTED SURGERY
Int J Med Robotics Comput Assist Surg (2012)
Published online in Wiley Online Library (wilevonlinelibrary.com) **DOI:** 10.1002/rcs.1417

ORIGINAL ARTICLE

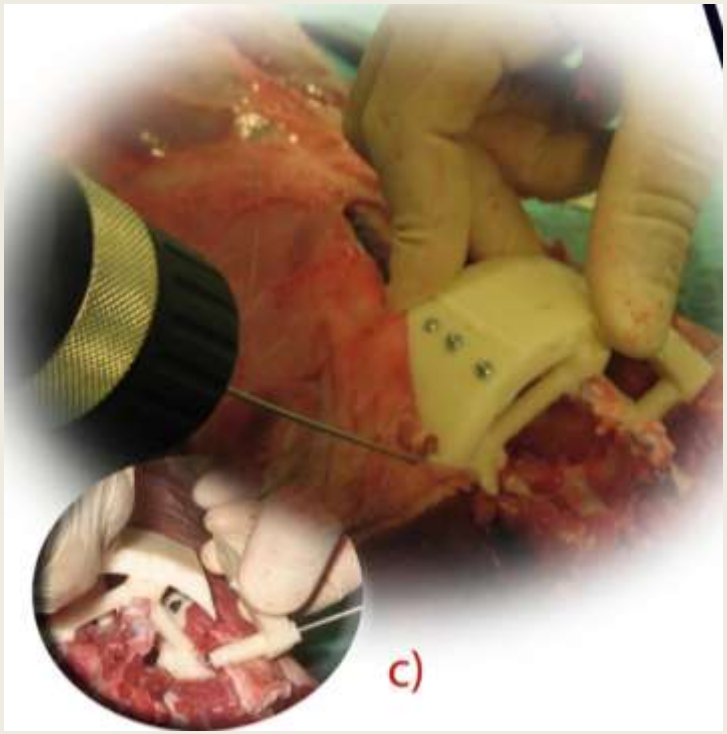
Electromagnetic navigation platform for endovascular surgery: how to develop sensorized catheters and guidewires

S. Condino[1*]
V. Ferrari[1]
C. Freschi[1]
A. Alberti[2]
R. Berchiolli[2]
F. Mosca[1]
M. Ferrari[1,2]

PATIENT SPECIFIC TEMPLATE FOR SPINE SURGERY



PATENTED SOLUTION



- Customized surgical templates, radiological images-derived
- The surgeon preoperative plan is transferred to the operative site, guiding the surgical drill to the optimal entry point and along the best trajectory

Int J Med Robot. 2013 Sep;9(3):298-304. doi: 10.1002/rcs.1439. Epub 2012 May 15.

An optimal design for patient-specific templates for pedicle spine screws placement.

Ferrari V[1], Parchi P, Condino S, Carbone M, Baluganti A, Ferrari M, Mosca F, Lisanti M.

e-SPres3D

Patient Specific Phantoms for simulation

1.
se

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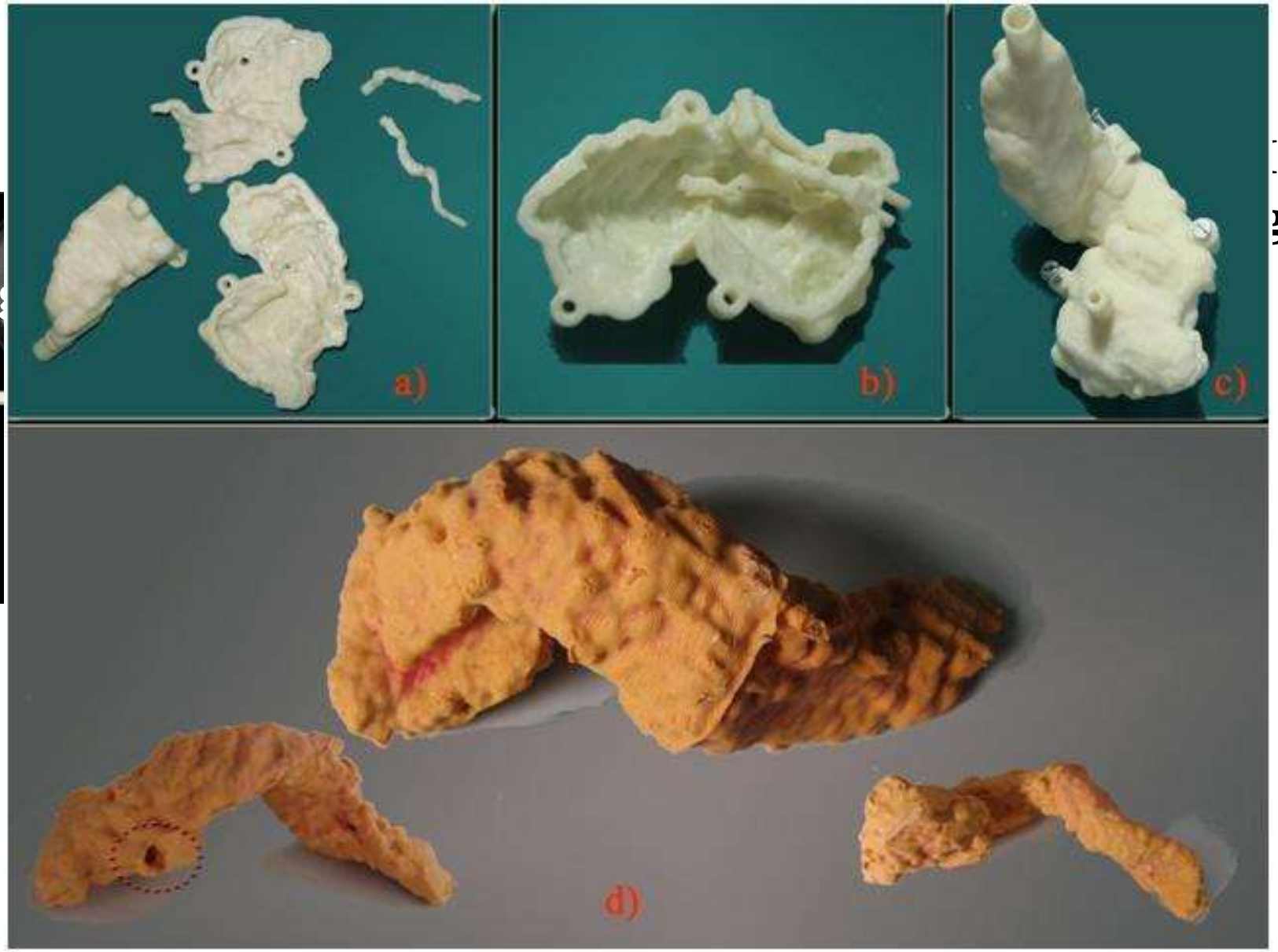
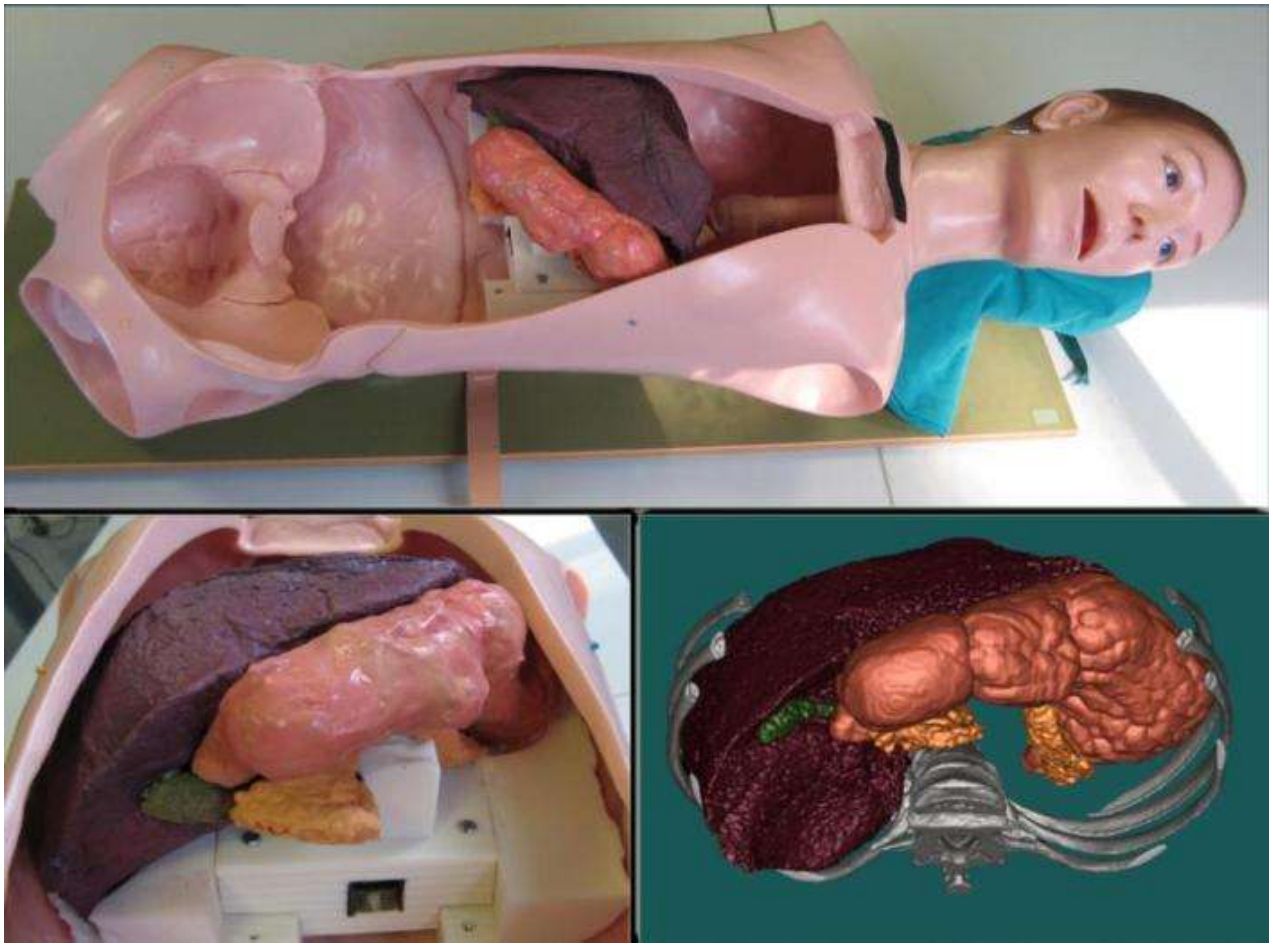


Patient Specific Phantoms for simulation



A.R.A.K.N.E.S.

The ARAKNES (Array of Robots Augmenting the KiNematics of Endoluminal Surgery) Project has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement num. 224565.

Other physical simulators @ EndoCAS

- US Breast Elastography phantom

- US PATIENT SPECIFIC Liver biopsy phantom

- Endovascular procedures PATIENT SPECIFIC phantom

Our phantoms in our training center

Surgical simulation programs

AMERICAN COLLEGE OF SURGEONS • DIVISION OF EDUCATION

ACCREDITED EDUCATION INSTITUTES

ENHANCING PATIENT SAFETY THROUGH SIMULATION

Surg Endosc
DOI 10.1007/s00464-013-3393-6

Distribution of innate ability for surgery amongst medical students assessed by an advanced virtual reality surgical simulator

Andrea Moglia · Vincenzo Ferrari · Luca Morelli · Franca Melfi · Mauro Ferrari · Franco Mosca · Alfred Cuschieri

BLS & ACLS programs

U.O. Neonatologia - Ospedale S. Chiara (Pisa)

Direttore: **Prof. Antonio Boldrini**

CENTRO DI FORMAZIONE E SIMULAZIONE NEONATALE

Resposabile: **Dott. Armando Cuttano**

MERESSINA
(MEchatronic Respiratory System SImulator for Neonatal Applications)

- Research Partners:

Neonatologia e Terapia Intensiva Neonatale, Azienda Ospedaliero-Universitaria Pisana

Dr. Armando Cuttano
Dr. Massimiliano Ciantelli
Dr. Rosa T. Scaramuzzo
Dr.ssa Marzia Gentile
Dr. Emilio Sigali
Dr. Paolo Ghirri
Prof. Antonio Boldrini

The BioRobotics Institute, Scuola Superiore Sant'Anna

Prof. Cecilia Laschi
Prof. Arianna Menciassi
Selene Tognarelli
Francesca Cecchi
Ilaria Baldoli

- Funding by:
  - AGENAS, Commissione Nazionale per la Formazione Continua - Italian Ministry of Health, grant "Sviluppo e ricerca sulle metodologie innovative nella formazione continua (2011)"
  - Azienda Ospedaliera Universitaria Pisana

- Starting date: March 19th, 2012
  Duration: 18 months
  Scientific coordinator: Dr. Armando Cuttano

Background: Respiratory diseases in newborns

Respiratory problems are among the main causes of mortality for preterm newborns → MECHANICAL VENTILATION

Risk of complications or side effects (e.g. Broncho Pulmonary Dysplasia)

- A continuous education program is necessary to train nurses and neonatologists
- **HIGH-FIDELITY SIMULATION** is the best strategy to reach the aim

State of the art – Neonatal respiratory simulators

commercially available:
- IngMar Adult/Pediatric Lung Model
- IngMar ASL 5000 Adult/Neonatal Breathing Simulator
- Premi HAL®S3009 and Newborn Hall®S3010 by Gaumard
- SimNewB by Laerdal

in research field:
- Cappa's neonatal breathing simulator, 2002
- Silvestri's open-loop controlled active lung simulator for preterm infants, 2011

- no complex breathing patterns
- positive pressure spontaneous breathing (a dynamic interaction with mechanical ventilators for triggered ventilation is not allowed)
- based on single or double compartments models

- bulky problems
- too complex for an easy employment during training sessions in Neonatal Intensive Care Units (NICUs)

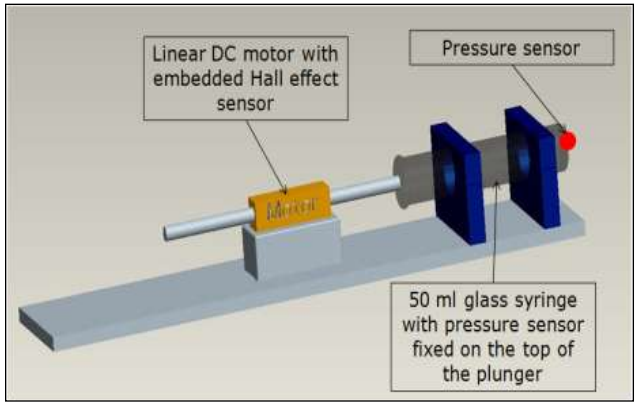
Project goal

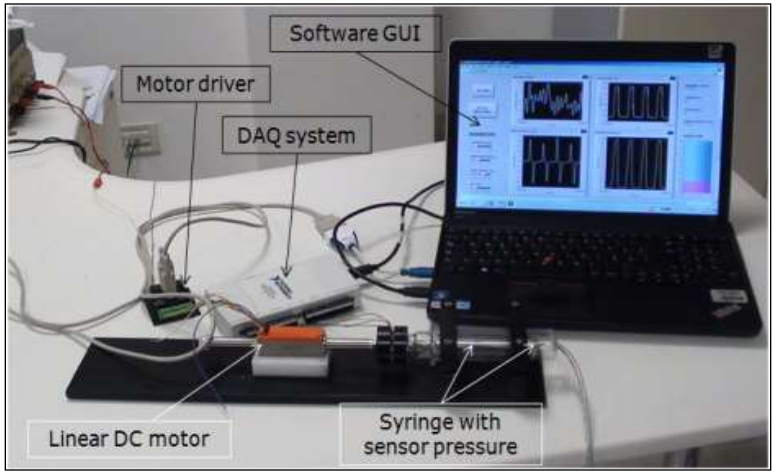
Development of an high-fidelity and versatile **neonatal lung simulator**:

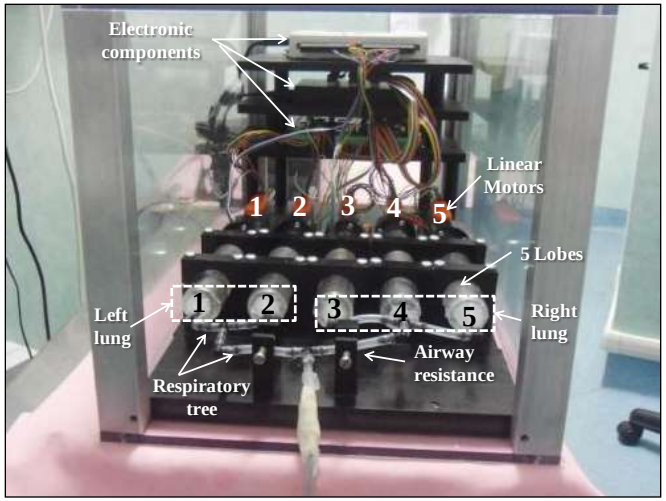
- Able to reproduce both **autonomous** and **mechanically assisted breathing**
- Good at simulating a wide range of **pulmonary conditions**
- **User-friendly** for clinicians' training sessions
- Suitable to be **integrated** into phantoms

MERESSINA prototype

1. Hardware:



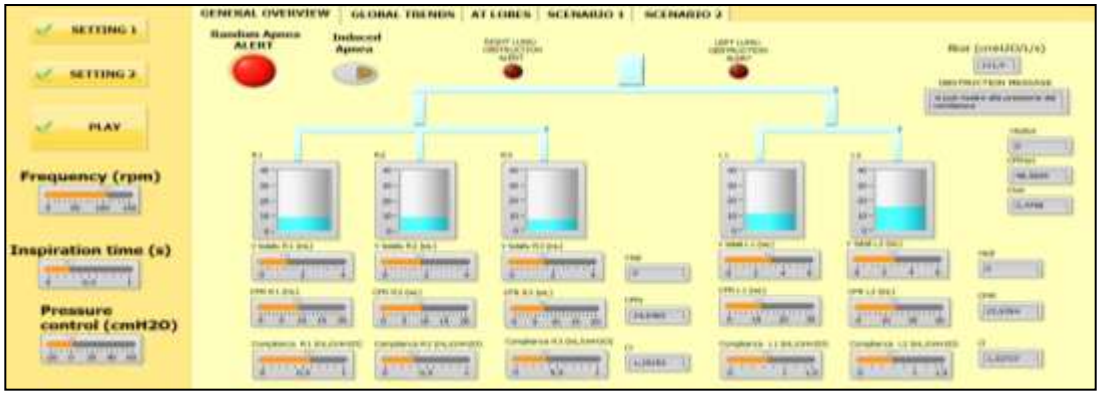




Baldoli et al., J Clin Monit Comput. 2014 Jun;28(3):251-60
Tognarelli et al., Conf Proc IEEE Eng Med Biol Soc. 2013;2013:457-60
Scaramuzzo et al., Med Devices (Auckl). 2013 Aug 8;6:115-21

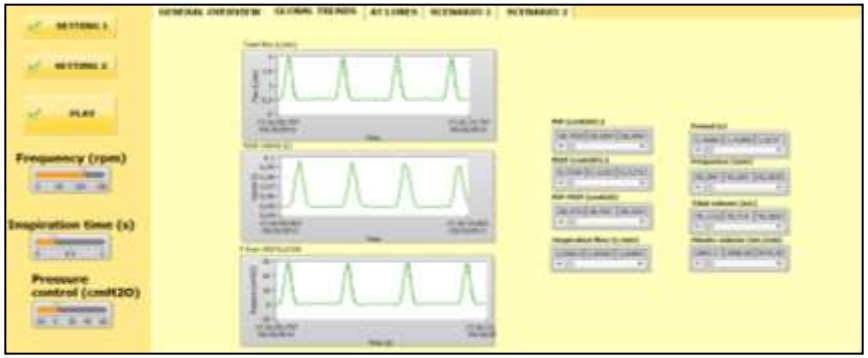
MERESSINA prototype

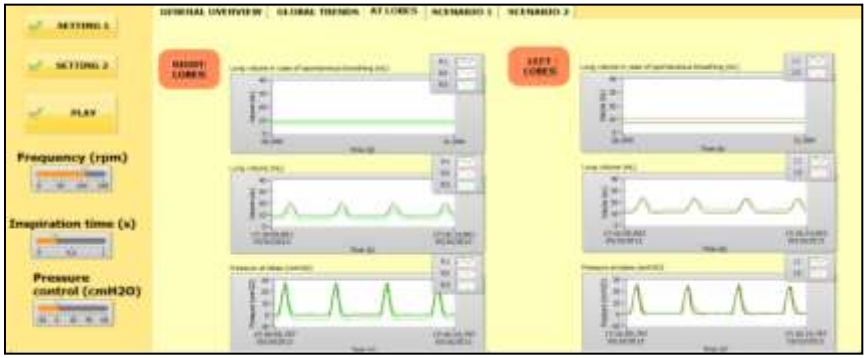
2. Software:

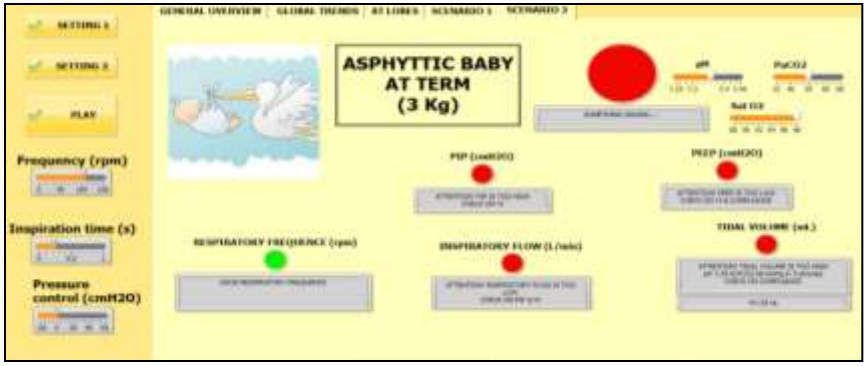


- **Management of simulation**:
-authonomous breathing
-controlled ventilation
-assisted/triggered ventilation

- **5 sheets** collecting:
-physiological parameters controls
-graphic, numeric and LED indicators







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