

SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA
Azienda Ospedaliero - Universitaria di Modena - Policlinico



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
Scuola di Specializzazione
in Fisica Medica

A LEGO MINDSTORMS BIOMECHANICAL PHANTOM TO SIMULATE BREATHING MOTION

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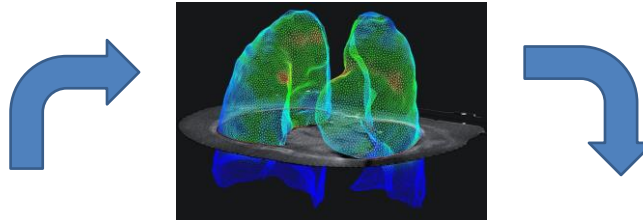


Dose warping methods for IGRT and Adaptive RT: dose accumulation based on organ motion and anatomical variations of the patients during radiation therapy treatments

- Tecnologie Avanzate S.r.l. (Italy)

Adaptive Radiation Therapy

Adaptive Radiation Therapy (ART) is a state-of-the-art approach that uses a feedback process to account for patient-specific anatomic and/or biological changes, thus, delivering highly individualized radiation therapy for cancer patients.



Needs for Clinical Practice:

1. Image Guided System
2. Fast Re-Contouring
3. Fast Re-Calculation
4. **Tools for Real-Time QA or Simulation**
5. **Predictive Tools for Biomechanical Approach?**

Missing?

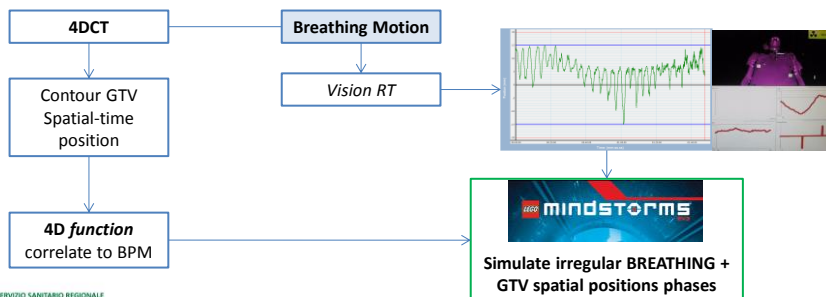
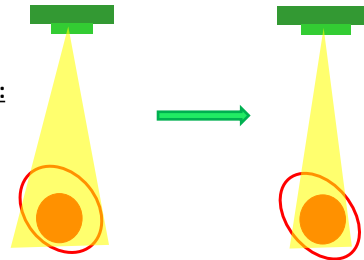
What is ready at Policlinico (SEE THE POSTER!!!)

1. Daily Setup Images (e.g. MVCT/kVCT)
2. Automatic PTV/OARs contouring
3. DIR and/or Warping methods
4. Hybrid deformable algorithms - Bayesian Network validation
5. Workflow automation (Scripting, GPU, Cluster, iCloud)
6. Predictive analysis Neural Networks
7. First Step on Dose Accumulation

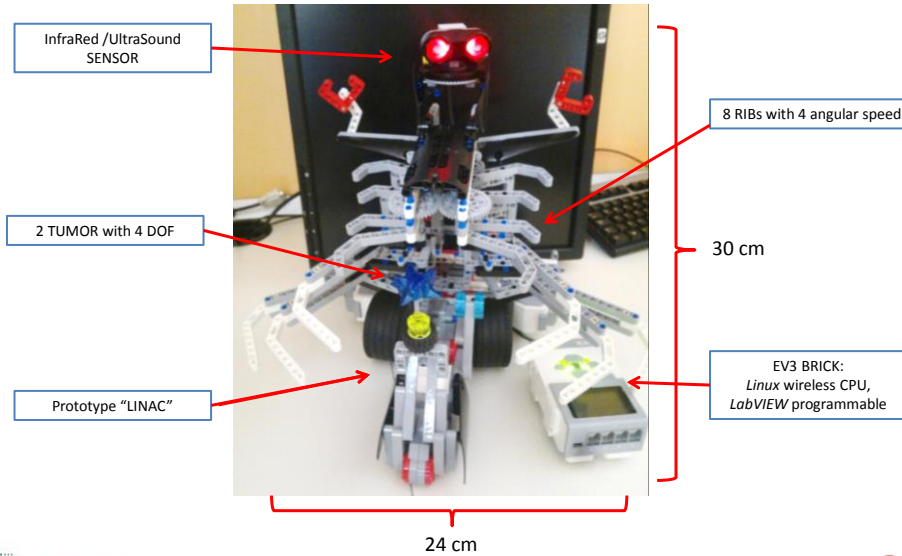
Biomechanical Approach



Aim:

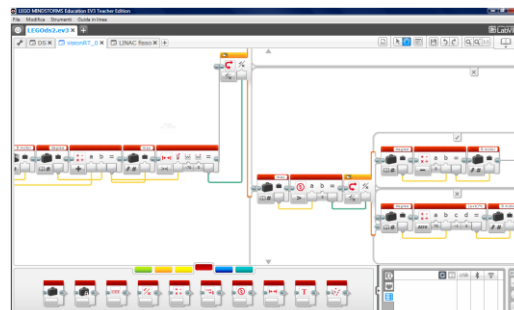


Real Time Robot

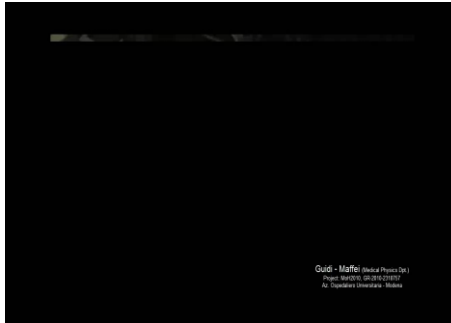


Lego Approach: Which-PRO?

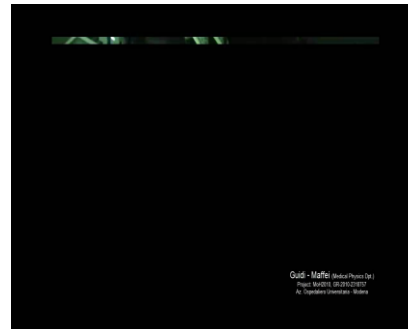
- Freedom offered by building bricks
- Low-cost/home-made solution
- Pediatric scale
- Plastic materials avoid artifacts
- Complete versatility with *LabVIEW* dedicated software
- Human 4D simulation reproducible



Didactic Phantom

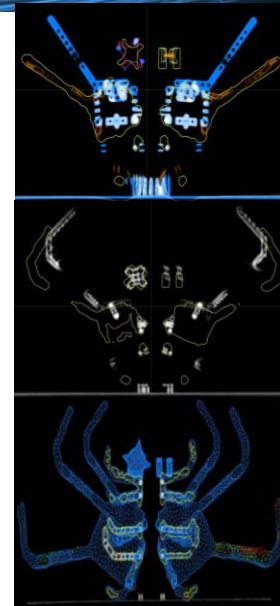
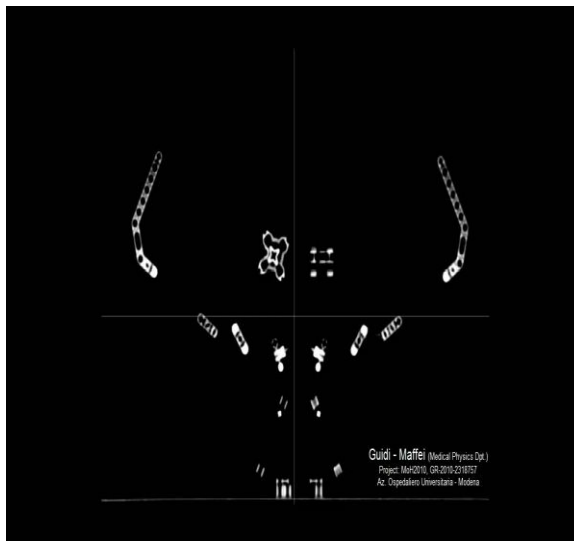


Standard Treatment Simulation

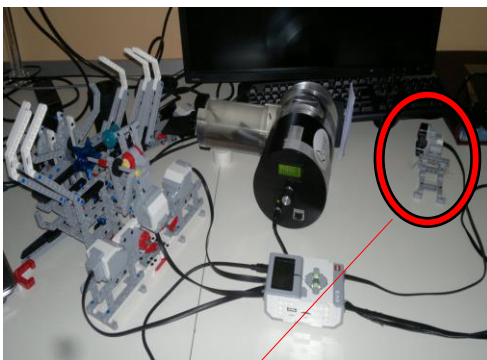


Tracking Tumor Simulation

4DCT, Mesh Reconstruction and ROI Tracking/Contouring



Breathing Real Time Simulation



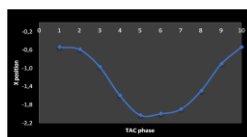
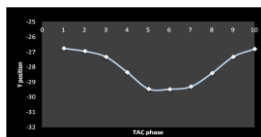
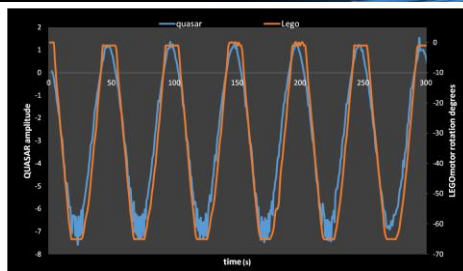
Quasar phantom, interfaced
with VisionRT software,
reproduces BPM



Through sensors, the ROBOT
emulates in real-time patient's
breathing motion

4D Breathing Simulation

Preliminary results



Conclusions

- Organ motion and deformation can lead divergence of treatments compared to the initial constraints
- Standard CT “freeze” images of Tumor and OAR
- 4DCT allows to follow dynamics parameters of breathing (spatial time localization)
- An anthropomorphic phantom can simulate the human physiology to follow and predict changes in morpho-dosimetry using external surrogate!
- 4D QA
- LEGO MINDSTOMRS can help to prototype idea and make some experimental with low cost

Suggestions

Questions?

Collaborations?

