Centre Léon Bérard

Projet ETOILE
Espace de Traitement Oncologique par Ions Légers dans le cadre Européen

Lung motion modelling to simulate dosimetry during cancer treatment

LIRIS
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Context

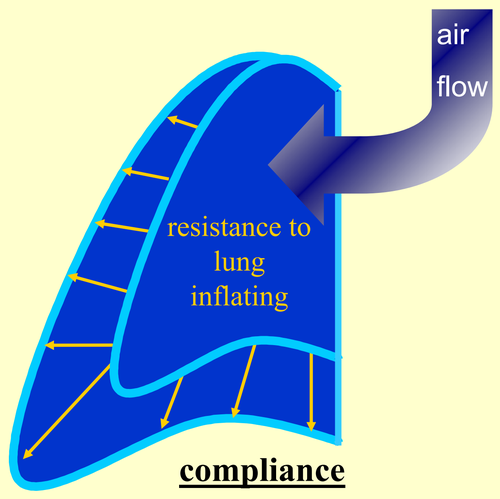
hadrontherapy necessities:

- accuracy
- organ motion detection
- customised treatment

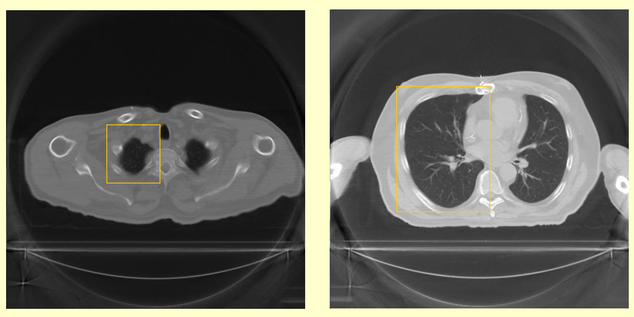
Mechanical parameters

Compliance
(physiological parameter)

Young modulus
(mechanical parameter)



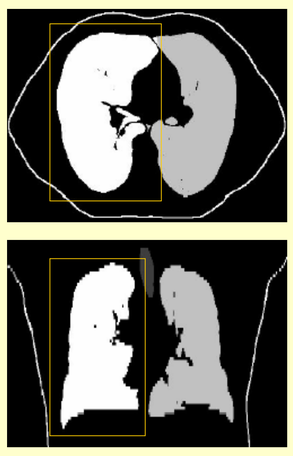
Geometrical parameters



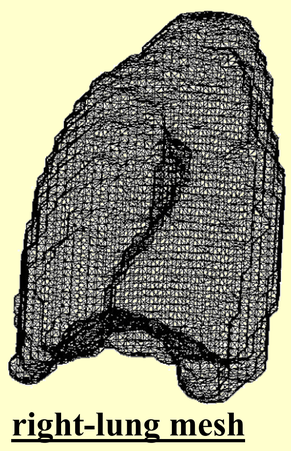
3D CT scans

voxel size:

0.94 x 0.94 x 5 mm^3



right-lung segmentation



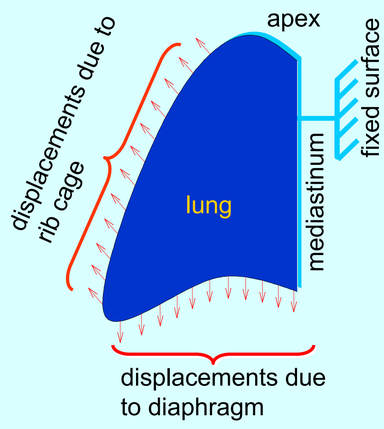
right-lung mesh

voxel size:

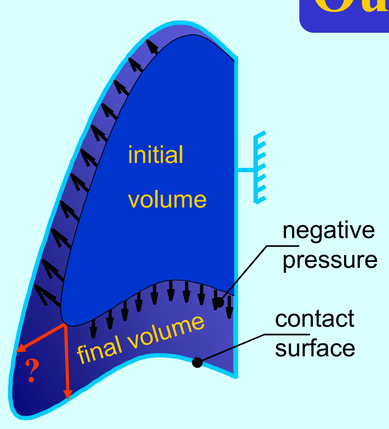
7.5 x 7.5 x 5 mm^3

Mechanical problem to solve

Motions and displacements inside the lung due to environmental constraints



Our solution



A uniform pressure around the lung is applied, at forced expiration state, until the simulated surface matches the final state

Continuous Media Mechanics laws

- *balance equation*
- *kinematics equation*
- *constitutive equation*

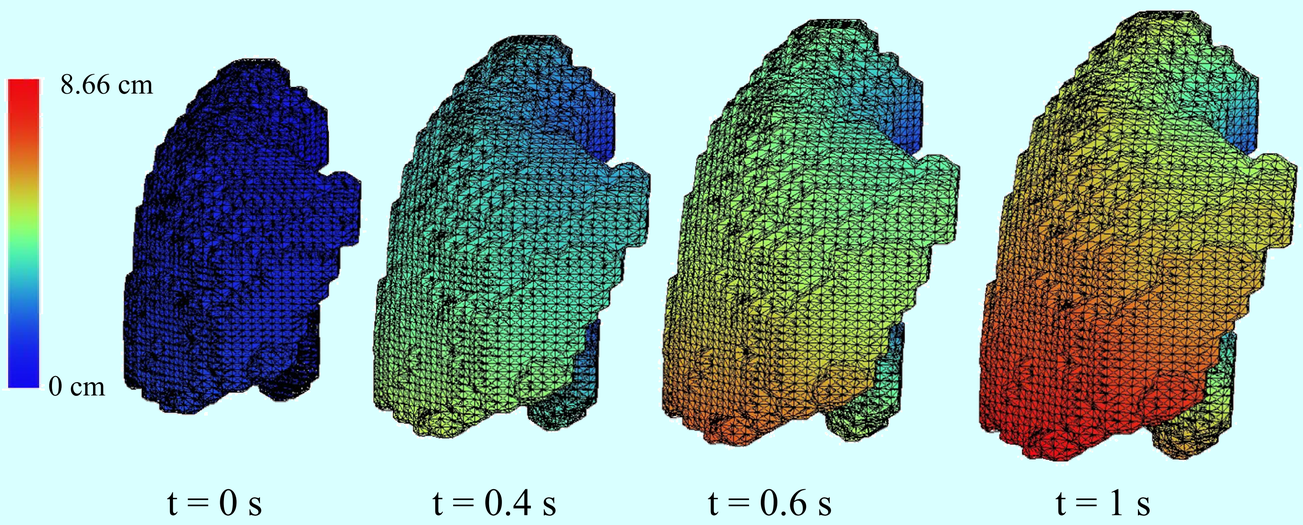
+

- *boundary conditions*

computed with finite element method

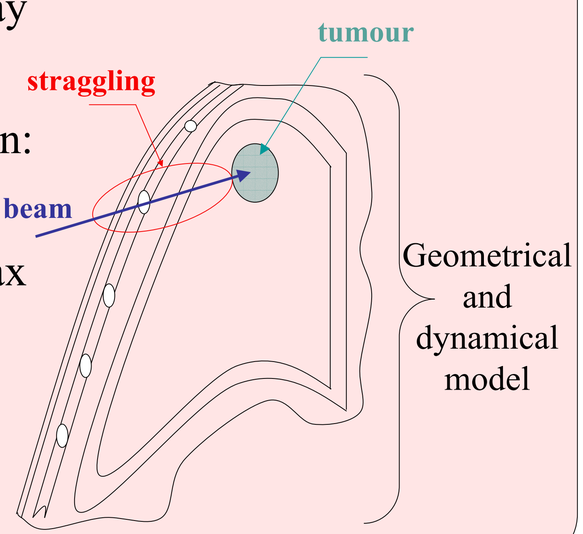
Results :

External surface variation during total lung inflating



Next step : Dynamic Dosimetry

- time dependant ionising ray propagation (ion or X-ray)
- static dosimetry calculation:
  - according to the beam position through the thorax
  - at different times
- dynamic dosimetry = integration over the time



Conclusion

- work based on medical collaborations
- clinical validation and lung environment integration required
- limits : anisotropy and heterogeneity