Fantocci

Phantoms

Scopo dei fantocci:

- Sviluppare fantoccio per trattamenti seno per:
 - Aumentare diversità dei dati per il nostro modello AI per 2D e 3D
 - Studiare casi più realistici per lo sviluppo del ALERT system

Vari passi:



Select suitable tissue equivalent material

- The materials must closely match the volume, density and chemical composition characteristics of the represented tissue for a proper radiological response at the energy of interest.
- The materials must be commercially available, relatively simple to fabricate and stable
- Should match tissue attenuation characteristics at >MeV (radiotherapeutic X-rays) as well as comparable tissue equivalence for X-rays with lower energies (CT scan)
- \rightarrow Study several physical properties: physical density, electronic density, HU ??

The **Hounsfield unit** value is directly related to the linear attenuation coefficient: **1HU** equals a 0.1% difference between the linear attenuation coefficient of the tissue as compared with the linear attenuation coefficient of water. Hounsfield units (HU)- measures the ability of a material to cause beam attenuation.

1000 HU (bone): 100% difference between the linear attenuation coefficient of the tissue as compared with the linear attenuation coefficient of water: factor 2 in linear attenuation coefficient (factor 2 smaller)

Dose deposition MeV X-ray in bone (J/kg): a factor 2 in absorbed dose?

I don't think there is a direct relationship between linear attenuation coefficient and dose...

Literature confirms (experience?)



Select suitable tissue equivalent material



- ✓ Contatto con Servizio Meccanico (Donato Orlandi, Danilo Tatananni, Daniele Cortis)
- ✓ Raise3DPro (filament): density was written in specifications
- Printed 8 small cubs and 8 larger cubes
- PP (rho=0.9 g/cm³) not possible, to be done
- \checkmark CTs made
- dosimetric measurements to be done

- 2. PETG nero
- 3. PLA bianco
- 4. ABS bianco
- 5. ABS Hyperspeed natural
- 6. ABS Hyper speed V2 natural
- 7. PET GF grigio
- 8. PA12 CF+ nero
- 9. PPA GF natural

Select suitable tissue equivalent material

Empirical approach

INFN Pisa: new printers!

- Stampante Form4B, filament, resina,...
- Stampante Bambolab
 - ✓ 10 materials selected
 - Now being printed!





Bio3DModel

- ✓ Contatto con Federica Giovannini
- ✓ 10 small cubes ordered
- Depending on TAC result, decide which ones are to be tested with dosimetric measurement



• Should be ready any time

Plans

Next

- Fantoccio ad incastro
 - Print at LNGS? Up to 2 materials at the same time
 - Print in Pisa? Up to 1 material
- Fantoccio reale:
 - Bio3D model: up to 7 materials

Work by Rossana



Select suitable tissue equivalent materials

\$



Large size (~35x35x20cm³) INFN? \$\$ Bio3DModel? \$\$\$\$

Plans

- Use them to
 - Enlarge data set for AI models (2D and 3D)
 - To develop and test alert system before testing on patients