DB06-12: Teaching Medical Imaging with Analogies

Dean Zollman, Bijaya Aryal & Spartak Kalita

Kansas State University

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Other Collaborators

- Leroy Salary, Norfolk State University, USA
- Hartmut Wiesner, LMU, Munich, Germany
- Manfred Euler, IPN, Kiel, Germany
Student Audience

- University
- Prior to entering medical studies
- One year of physics
  - Algebra-based
  - Only physics course
- Change parts of this course
  - Not replacing the course
Goals

• Conduct research on student reasoning and mental models related to application of physics to contemporary medicine,

• Develop active engagement instructional materials on applications of physics to contemporary medical diagnosis and procedures, and

• Integrate physics and contemporary medical applications throughout the physics course for medical students
Approach to the science

• Focus on the physics not the medicine
  – That’s what I know
  – Students could not analyze a PET scan but
    could describe the underlying principles

• Qualitative problem solving

• Use visualization frequently
Physics applications to medical diagnosis & treatment such as

- X-rays & CT Scans
- Ultrasonic Imaging
- Positron Emission Tomography
- Magnetic Resonance Imaging
- Lasers in diagnosis & surgery
Research on Learning

- Clinical Semi-structured Interviews
  - One-on-one (interviewer & student)
  - Elicit student reasoning & mental models

- Teaching Interviews
  - Small groups of students
  - Do the best we can to teach a limited topic
Positron Emission Tomography (PET)
Positron Emission Tomography (PET)

- Positron emitter injected into body
- Positrons annihilate with electrons
- Detection of 2 gamma rays determines the location of the annihilation
- Watch body functions as they occur

From Wikimedia Commons
PET Coincidence Analogy 1

• Focus on coincidence & what it tells us
• Hidden collision carts
• One student releases the carts
• Another student sees the carts only at the end of the track
• Determine where the carts started
PET Coincidence Analogy 2

- LEDs hidden inside a cake carrier
- For each “annihilation” two lights flash
- Student determine the “location” of the group of annihilations.
Computer Tomography
Back Projection used in CT Scans
Back Projection with Legos

- LED source;
  Photodector

- Configuration of translucent Lego blocks hidden from view

- Determine the configuration from the light absorption data
Example

[Image of a hand-drawn grid with numbers and a corresponding 3D model built with LEGO bricks]
Attenuation of Light adds additional information
Interactive Simulations for CT

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<thead>
<tr>
<th>Start</th>
<th>Korrektur</th>
<th>Addieren</th>
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Didaktik der Physik

Ludwig Maximilian University, Munich
More sophisticated method of signal analysis leads to better results

Images of an orange

x-ray

CT with back projection

Brandeis University Detector Group
http://web.phys.ksu.edu/

dzollman@phys.ksu.edu