First in Human Clinical Trials of Carbon Nanotube X-ray Stationary Tomosynthesis

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Introduction

- Pseudo-3D imaging modality
- Projection images acquired at different angles
- Projections reconstructed into 3D image volume
- Carbon nanotube cathodes spatially distributed
- No mechanical motion required to obtain projections

Stationary Tomosynthesis

Advantages for Breast Imaging Application

- s-DBT has many advantages over current commercial DBT modalities
  - Higher spatial resolution
    - No focal spot motion blur
    - No X-ray source gantry vibration
    - In both in-plane and depth directions
  - Decreased image acquisition time
  - Increased microcalcification conspicuity

Advantages for Chest Imaging Application

- Digital chest tomosynthesis (DCT) has better nodule detection sensitivity than chest radiography, and lower dose to patient compared to CT
- s-DCT has many advantages over current DCT systems
  - Higher spatial resolution
  - Decreased imaging time
  - Physiological gated imaging

Clinical Study Design

- 100 patients scheduled for diagnostic imaging were recruited under the university’s institutional review board regulations (IRB)
  - Patients with breast thicknesses, 0 – 60 mm
  - No prior biopsies and needle localizations
  - Patient and operator safety
    - Before use on patients, system had to be checked for electrical safety (MET Labs) and radiation safety (EHS)
  - Developed Automatic Exposure Control (AEC) table
  - Training of radiology technician
  - Began Patient imaging (Dec 2013)

First patient image.

Photograph of the preclinical s-DBT system in N.C. Cancer Hospital. Courtesy of UNC Lineberger Comprehensive Cancer Center.

- Reconstructed CC image slices of patient 1 at heights of (A) 13.5 mm and (B) 26.5 mm.
- The blue and green boxes illustrate different objects coming into focus at the different heights.
  - The blue box shows a mass that has been marked by a metal biopsy clip and the yellow box shows a microcalcification cluster.
- Total exposure was 91 mAs over 15 projections with a peak voltage of 34 kVp.

Stationary Digital Chest Tomosynthesis (s-DCT)

- Demonstrated feasibility of s-DCT using a bench-top system.
- The s-DCT system is being prepared for safety inspection for the clinical trial later this year.
- 100 patients will be recruited for diagnostic imaging under IRB regulations.
- Work is ongoing.