

AbstractID: 7966 Title: Advances in Simulation Tools and Their Applications to CT, PET/CT and SPECT/CT

In CT, PET/CT and SPECT/CT imaging research, we are often involved in the design, development and evaluation of instrumentation, data acquisition methods, and image reconstruction and processing techniques. Ideally, clinical trials using patient images from actual imaging systems should be used in the evaluation studies. In practice, clinical trials are difficult to perform due to the difficulties and the high costs in acquiring 'good quality' clinical images and physicians' time to read them. Most importantly, there is a lack of known 'truth' in most clinical images. In the past, although computer simulation methods allowed generation of a large number of images with known 'truth', they suffered from the availability of computer generated phantoms that realistically model human anatomy and physiological functions and the ability to generate simulate data that accurately represent data acquired from actual medical imaging systems. We have developed a 4D computer generated phantom that are based on the Visible Human data and cardiac and respiratory gated MRI and CT data from normal human subjects. The non-uniform rational b-splines (NURB) computer graphics tools were used to allow accurate modeling of the shapes of 3D anatomical structures and generation of collections of phantoms that represent variations in anatomical structures and physiological functions found in different patient populations. Also, analytical and Monte Carlo simulation methods have been developed to provide data that accurately model the imaging system geometry, and photon interactions in the phantom and within the imaging system. Applications of the simulation tools to CT, PET/CT and SPECT/CT imaging research will be demonstrated with sample research projects. They demonstrate the potential utility of the simulation tools in a wide variety of applications in the research and development of instrumentation, image reconstruction and processing methods of different medical imaging modalities in the years to come.