AbstractID: 7964 Title: Personalized coronary imaging with a virtual catheterization laboratory

Purpose:
Cardiovascular disease is considered the leading cause of death in the US, accounting for 38% of all deaths, with an estimated direct and indirect cost of almost $400 billion. Coronary artery disease is principally identified and diagnosed using contrast angiography and cardiac CT imaging acquisitions. The success of the detection task depends on the physicians' capability to diagnose the presence of this disease and also relies very much on the image quality. The quality of the imaging modalities is also a very important component in coronary artery disease treatment-planning, follow-up, and in image-guided cardiac and vascular interventions as it directs and influences the physicians' options and actions. Our goal is to examine those imaging modalities and develop recommendations for patient- and case-specific imaging protocols.

Methods and Materials:
We developed a virtual catheterization laboratory which includes an imaging system simulator, patient models, and a virtual radiologist. The imaging system simulators use Monte Carlo techniques for the x-ray and particle transport and detection. The patient models are male and female anthropomorphic phantoms, which include detailed anatomical descriptions of each organ, including high resolution hearts with realistic statistical models of coronary artery pathology. The virtual radiologist uses mathematical and computer models to simulate human detection performance. By simulating multiple images we can test system parameters such as the geometry, resolution, scatter, and beam quality which reduce the x-ray dose and iodine contrast quantities administered to the patient.

Results:
We developed a realistic x-ray imaging simulation suite to evaluate and optimize coronary artery disease diagnosis and treatment.

Conclusions:
The development of improved personalized imaging acquisition protocols using modeling tools has the ultimate goal to reduce patient mortality rates and improve treatment outcomes related to cardiovascular disease.