Suppression of blooming artifact in coronary computed tomography angiography via DIRA

Myocardial infarction is the most common cause of death in high-income countries. One of the causes is plaque building up along the inner walls of the arteries of the heart, which narrows the arteries and reduces blood flow to the heart. Coronary computed tomography angiography is used to visualize these arteries and help doctors to diagnose the disease. Accurate determination of the severity of the disease is, however, difficult when the plaque contains high concentration of calcium. Conventional single-energy computed tomography (SECT) may overestimate the amount of calcification by a factor of 2-3 owing to an image artifact called blooming. Conventional dual energy computed tomography (DECT) does not significantly improve the results. An improvement may come from DECT using model based iterative image reconstruction (MBIR) algorithms. Our research group is developing an MBIR algorithm called DIRA. Of interest is whether the algorithm can suppress the blooming artifact and thus increase the diagnostic accuracy of coronary computed tomography angiography.

The task:

1. Design a mathematical phantom simulating heart arteries
2. Calculate projections taken by a DECT scanner using simulation software from Siemens. Reconstruct these projections via the DIRA algorithm. Modify the algorithm so that it suppresses the blooming artifact, and analyze the results.

Requirements:

The student should be familiar with general principles of computed tomography and interactions of x- rays (10 – 150 keV) with matter. Knowledge of Matlab is needed. Suitable for medical physics, biomedical engineering or electrical engineering students.

The work will consist of computer simulations, software development, and evaluation of data. The student will learn about dual-energy computed tomography. Active approach to problem solving will be encouraged; results will be discussed in a research group. Student's location: the Division of Radiological Sciences, Linköping University.

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