# Implementation and evaluation of a basis material decomposition algorithm in dual-energy computed tomography

Dual-energy computed tomography (DECT) uses two different x-ray beam qualities (x-ray tube voltages) to obtain information about internal structures of imaged objects. An *image-based* basis material decomposition (IBBMD) in DECT first reconstructs images obtained at the two different tube voltages and then uses the images to determine material composition of the imaged object. Alvarez and Macovski proposed an alternative approach in 1976. Their *projection-based* basis material decomposition (PBBMD) algorithm extracts information about material composition of the imaged object directly from projection data.
Significant improvements have been made to DECT scanners since the time the PBBMD algorithm was first proposed and evaluated. Of interest is how this algorithm performs with contemporary DECT machines. Our research group has developed a *model-based iterative image reconstruction algorithm* (DIRA), which utilizes the IBBMD approach in each iteration step. We would like to compare the performance of DIRA and PBBMD. The work could improve accuracy of radiation treatment planning. At Linköping University, we have access to the Siemens Somatom Definition Flash DECT scanner at the Centrum for Medical Imaging Science and Visualisation (CMIV) and we use CT scanner simulation software obtained from Siemens.

**The task:**

1. Implement the Alvarez and Macovski's PBBMD algorithm in Matlab.
2. Evaluate performance of the algorithm for mathematical phantoms.
3. Compare performance of the PBBMD algorithm and DIRA.

**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 software development, data processing and performance evaluation. The student will learn about the Siemens Somatom Definition Flash scanner and dual-energy computed tomography in general. 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.

For more information contact
- Gudrun Alm Carlsson, Prof em, (Gudrun.Alm.Carlsson@liu.se) or
- Michael Sandborg, Prof, (Michael.Sandborg@liu.se) or
- Maria Magnusson, PhD, (Maria.Magnusson@liu.se) or
- Alexandr Malusek, PhD, (Alexandr.Malusek@liu.se)