Part 1

A Siemens Definition Edge 128 slice CT scanner has been commissioned and taken into clinical use at the emergency department at Linköping University Hospital. You and your colleague, a medical physicist, are asked by the head radiologist to inform and explain, to the junior resident radiologist and radiographers, the new CT’s features and benefits compared to the old 16 slice scanner that served this department well for almost a decade. Since both of you were members of the group that formulated the specifications for purchasing the new CT you are ideal for the task.

You try to recall some CT artefacts that are important to minimize such as beam-hardening, partial volume, metal and photon starvation artefacts. You also remember that the of choice reconstruction kernel has a large effect on the sharpness and noise characteristics of the images. But what physical effect is responsible for the contrast in CT?

The medical physicist was also interested in the iterative reconstruction algorithm that some CT manufacturers claim may replace the fast, but artefact-prone filtered back-projection reconstruction algorithm that has been used for decades. She claims that with iterative reconstruction or post-processing 2D and 3D filters it is possible to reduce the patient dose and still maintain or even improve the clinical image quality.

The neuroradiologist was however not impressed with the first CT brain examinations on the new CT but his colleague who mostly reads CT thorax examinations were satisfied with the quality of the images in spite of the patient dose (reference quality mAs and CTDIvol) being reduced by 30%. The physicist was also impressed with the improved dynamic collimation that, particularly for short scan length, will reduce the dose-length product of the examination. One of the radiographers reminds his colleagues to choose the most appropriate wedge (or bowtie) filter to fit the patient or body part size and to always centre the patient in the gantry.

<table>
<thead>
<tr>
<th>Photon starvation artefact</th>
<th>Beam hardening artefact</th>
<th>Beam hardening artefact</th>
</tr>
</thead>
<tbody>
<tr>
<td>(What effect is causing this artefact?)</td>
<td>(without correction)</td>
<td>(with correction)</td>
</tr>
</tbody>
</table>

![Image of artefacts and filters](image-url)
Case 2 Medical Imaging TBMT02

Part 2

One month later the radiologist who is responsible for the scan protocol for abdominal CT contacts you and wants to optimise scan protocols for CT liver and pancreas. He has read a paper that suggest that you can half the patient dose and still, at least for non-obese patients, have the same image quality if you apply an adaptive 3D post-processing filter to your images. He asks you to assist in setting up a clinical evaluation and use his fellow radiologists to assess the quality of the image series. You are keen to help him and wonder how to best assess the images and how to analyse the data after the images has been evaluated by the radiologist. You have heard of the EU clinical image criteria (IC) and of a technique called visual grading (VG) using image criteria scoring.

Normal dose (12 mGy)  
Half dose (6 mGy) + No filter  
Half dose (6 mGy) + 3D filter

Borgen et al. Application of adaptive non-linear 2D and 3D post-processing filters for reduced dose abdominal CT Acta Radiologica 2012; 53: 335–342

When you start talk to people at CMIV you find out that a radiographer has started to address a very similar task. She is comparing Siemens iterative reconstruction denoted SAFIRE with traditional FBP and presents to you some preliminary results, indicating that with iterative reconstruction, image quality can be maintained or even improved with significant dose reduction.

When you talk about your job with your friends they sometime ask you why you spend so much time minimizing patient exposure and what the risks are with high organ dose. One friend had recently have had his son scanned in the emergency department CT scanner when the son had a concussion falling of his bike. Your friend remembers that he was given a lead apron as he was assisting the radiographers in the x-ray room while his son’s head was scanned. But why was not his son given a lead apron? Of course you know why.