ARTIFACT REDUCTION IN CT IMAGES

Beam hardening and cupping artifacts

CHALLENGES: Health, demographic change and wellbeing

PRODUCTIVE SECTOR: Health care

PROBLEM DESCRIPTION

In computer tomography the reconstructed CT images suffer from different types of errors causing artifacts, which may obstruct the proper diagnosis.

CHALLENGES AND GOALS

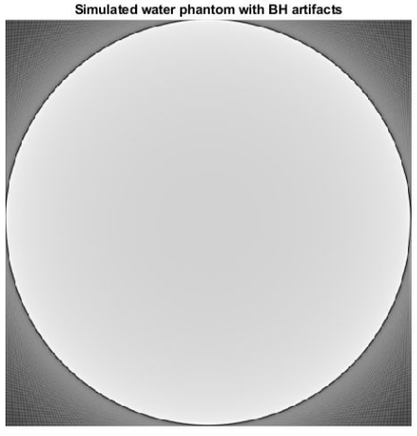
The aim of this project was to develop an efficient method for the correction of cupping artifacts caused by beam hardening on CT images. Challenges include model construction and parameter optimization. The key problem is to estimate the relative intensities of the X-ray components, and the associated attenuation coefficients.

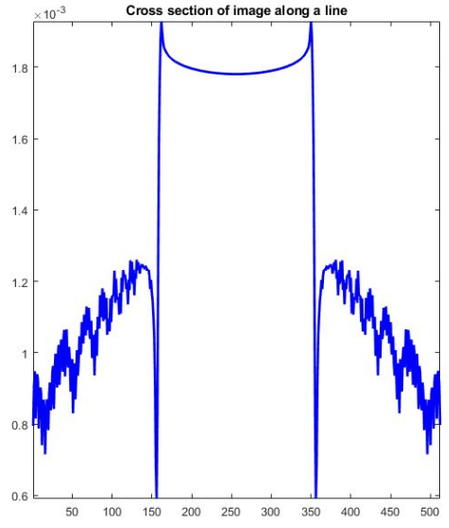
MATHEMATICAL AND COMPUTATIONAL METHODS

The mathematical model of beam hardening had to be properly discretized and to be reformulated to make it suitable for the use of an efficient optimization method.

A so-called variable projection method was developed for the nonlinear optimization problem.

The method worked out for the single material was generated to the multi material case.





A simulated homogeneous material with cupping artifact and its cross section.

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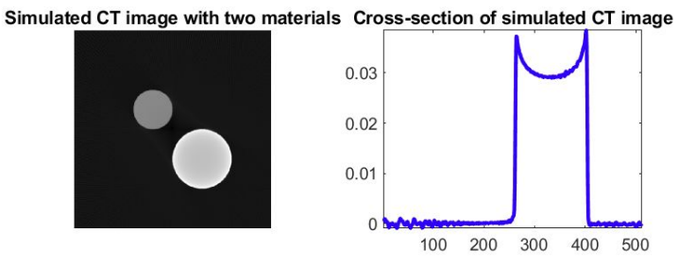
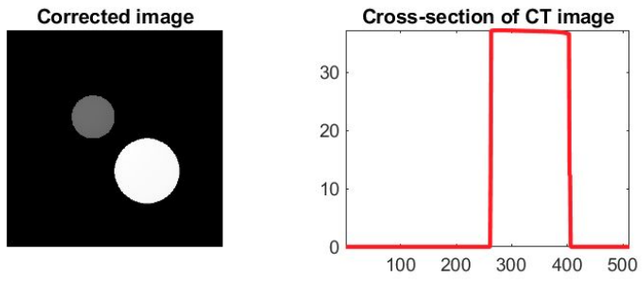
Results and Benefits

A novel method, that performs better than state-of-the art, was developed for reducing cupping artifacts in CT images. The spectral calibration of the CT equipments is performed by using homogeneous objects with well-known attenuation properties, such as a phantom filled with water. The proposed single material correction algorithms support this process. The general case correction algorithms can be used to approximate and correct artifact-ridden scans while the system is in day-to-day use.

An efficient method was developed for the reduction of the so-called cupping artifacts caused by beam hardening on CT images.



Simulated image of two materials with cupping artifact.



Simulated image after cupping artifact removal.

HU-MATHS-IN
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SZÉCHENYI 2020
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