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ADAPTIVE TRIANGULAR MESH FOR PHASE CONTRAST IMAGING

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1. Introduction

Attenuation contrast is based on the absorption of x-rays by a material. A conventional CT scan computes characteristic attenuation coefficients in discrete pixels on a regular grid modeling the material. Phase contrast CT adds two additional contrast channels: phase and dark-field. Dark-field contrast is based on scattering of the x-rays by microstructures. Both dark-field scattering and absorption happen at a constant rate in every compound of the material. Phase contrast, however, is caused by refraction of x-rays at interfaces between compounds differing in refractive index. [1]

Greater pixel sizes limit the resolution of structures seen in a CT scan. However, a higher amount of (smaller) pixels increases computational costs.

An adaptive grid has smaller pixels around interfaces between different compounds, and larger pixels in homogenous areas. This way, a sharp image can be made with a limited amount of pixels. Adaptive cartesian grids for reconstruction algorithms have been produced in the form of quadtree grids using the gradient of the image as a weight for which pixels to downscale. [2]

In this paper, an adaptive random triangular mesh is constructed, appropriate for a phase contrast CT scan.

2. Materials and Methods

The convergence of the triangular mesh to an interface was tested with a simulation of a homogeneous disk with an attenuation index of 0.01 and a refractive index of 0.95. This means the only interface is the one between the disk and air, which is a circle.

Each iteration step, every triangle of the mesh is given a score based on the computed gradient of the attenuation coefficient (from ray intensity data) in that triangle. Then, Chew's second algorithm [3] is applied to add an extra input vertex in the triangle with the highest score.

Simultaneously, the input vertices are given a score based on the calculated gradient at these vertices. Each iteration step, the vertex with the lowest score is removed from the triangulation.

3. Results and Conclusion

The mesh converges to the circle forming the edge of the absorbing disk (shown in Figure 1).

This means a mesh suitable for describing refraction at the interface between air and this disk is obtained.

This adaptive mesh shows the potential to separate different compounds of a general material efficiently, so that a good description of phase (and dark-field) contrast is possible with lower computational costs.

4. Acknowledgements

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5. References

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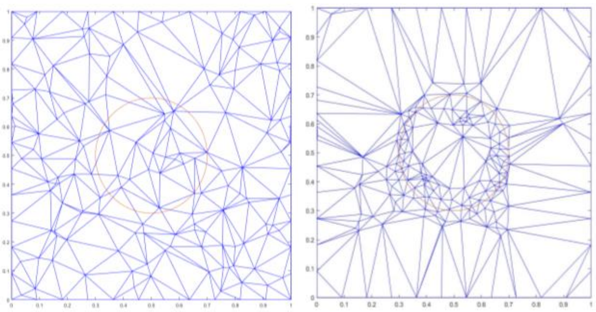

Figure 1. Mesh before (left) and after (right) a few adaptive iteration steps. In orange, the edge of the absorbing disk is shown.