

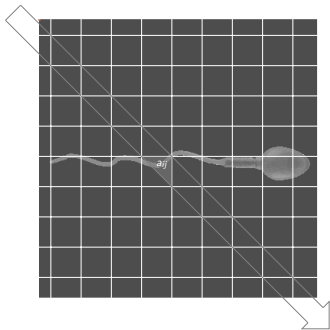
Using Futhark for a fast, parallel implementation of forward and back projection in algebraic reconstruction methods - A pre-study

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The system matrix



$$\mathbf{A} = \begin{pmatrix} & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \end{pmatrix}$$

Dimensions: 10^5 (width) and 10^6 (height).

Solve the problem:

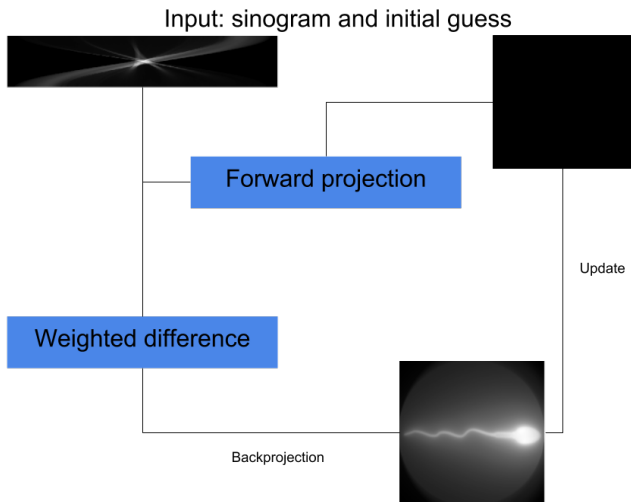
$$\mathbf{f}^* = \operatorname{argmin}_{\mathbf{f}} \|\mathbf{p} - \mathbf{A}\mathbf{f}\| \quad (1)$$

iteratively using this update step:

$$\mathbf{f}^n = \mathbf{f}^{(n-1)} + \mathbf{C}\mathbf{A}^T \mathbf{R}(\mathbf{p} - \mathbf{A}\mathbf{f}^{(n-1)}), \quad (2)$$

where \mathbf{C} and \mathbf{R} are the diagonal matrices containing the inverse column and row sums of the system matrix respectively.

SIRT



- High level data-parallel, and purely functional array language
- Comes with a heavily optimising ahead-of-time compiler
- Has performed well on several benchmarks
- Hardware-agnostic



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Fast parallel algorithms for the x-ray transform and its adjoint.
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The Mathematics of Computerized Tomography.
Society for Industrial and Applied Mathematics, 2001.



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In *Proceedings of 2011 International Conference on Electronic Mechanical Engineering and Information Technology*, volume 9, pages 4527–4530, Aug 2011.