

Iterative CT Image Reconstruction Using Neural Network Optimization Algorithms

(OTT ID- 1639)

**Inventors: Dr. Jun Zhang, Professor, and
Hongquan Zuo, Graduate Student**

**Dept. of Electrical Engineering and Computer Science,
UW-Milwaukee**

Smruti Patil, PhD, IPMM
Licensing Associate
1440 East North Ave.
Milwaukee, WI 53202
Tel: 414-906-4657
smruti@uwmrf.org

- ❑ Medical imaging software market is driven by the increasing need for early diagnosis and preventive medicine
- ❑ AI is bringing a paradigm shift in healthcare, powered by increased availability of large volume data and sophisticated imaging such as X-ray CT
- ❑ Iterative reconstruction (IR) methods are often used in CT image processing
- ❑ Current IR methods such as Coordinate descent offer quality images but have some drawbacks:
 - Hard to parallelize to handle large complex data simultaneously
 - Requires longer running time
 - Expensive

- ❑ Iterative reconstruction (IR) algorithms have been demonstrated to produce better image quality for CT image reconstruction
- ❑ Deep neural network training algorithms are used to improve the optimization in IR process
- ❑ ANN algorithms used: Momentum and Adam
- ❑ Pilot tests indicate they provide
 - Faster convergence than traditional algorithms (basic gradient descent and coordinate descent) used in IR process
 - Can be used in parallel instead of sequential computation
 - Significantly reduce running time
 - Easy workflow integration

- ❑ Provisional patent application (PPA) filed in March 2019

Current Status

- ❑ Proposed technology is a part of active on going research program at UW-Milwaukee
- ❑ Seeking collaborative partners for development and testing to demonstrate the acceleration of CT image reconstruction is various other ANN algorithms

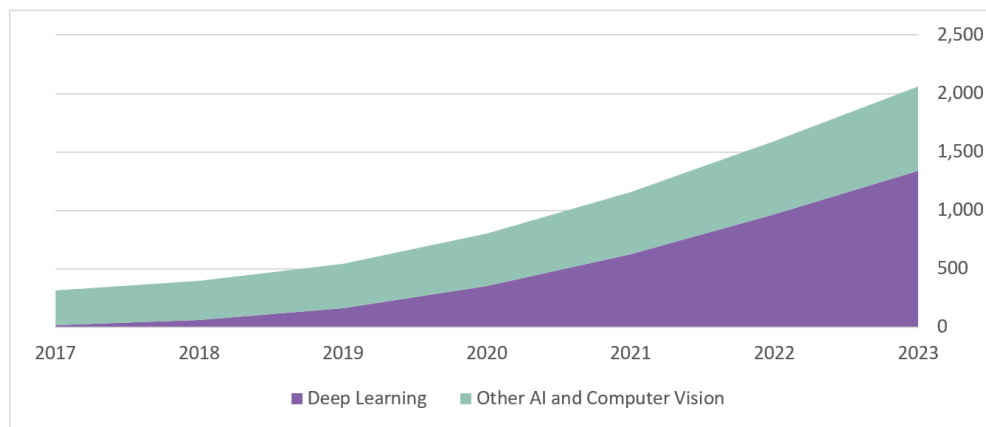
Applications

- ❑ The proposed technology can be used in CT image reconstruction process – Iterative Reconstruction
- ❑ Medical CT imaging, AI based medical software, ANN in medical imaging

Market

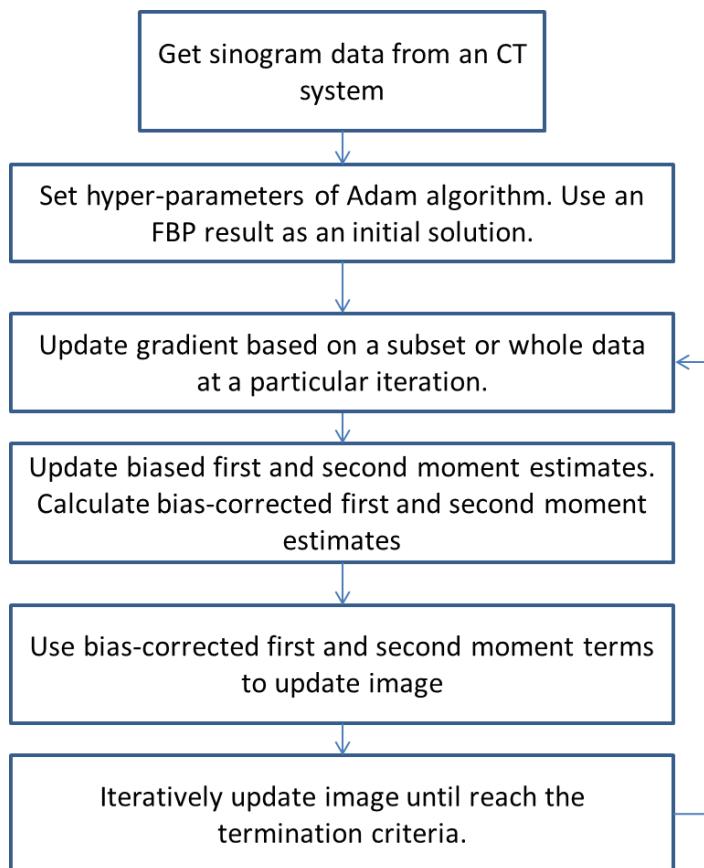
- ❑ AI in Medical Imaging to Top \$2 Billion by 2023

World Market for AI-Based Medical Image Analysis Software by Algorithm Type
Revenue Forecast (\$m)

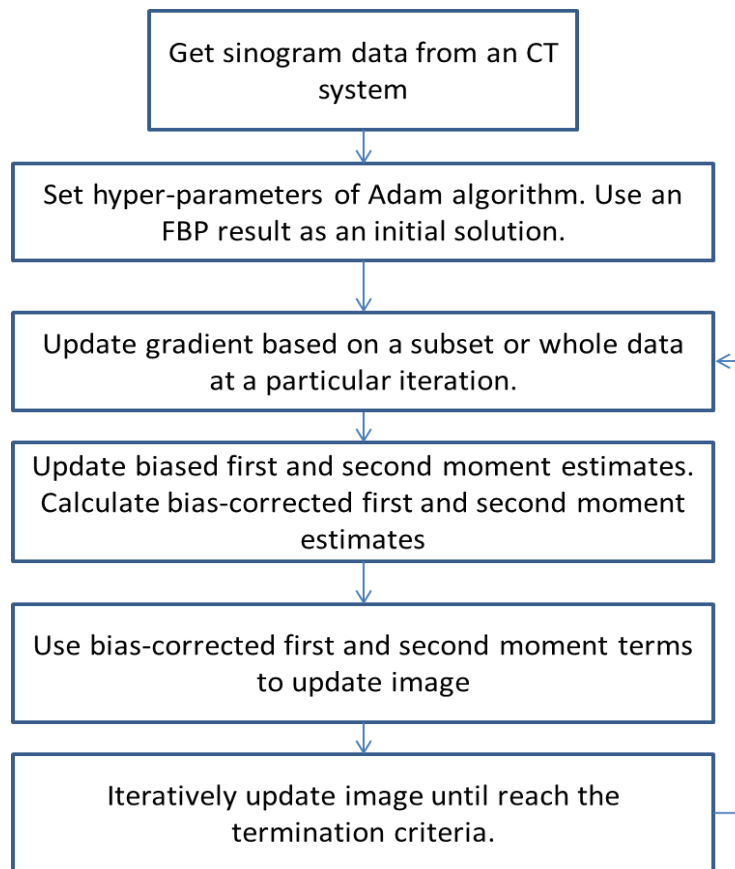


Flow charts for two deep neural network training algorithms used in current work

Momentum Algorithm



Adam Algorithm



Competitive and Faster Results

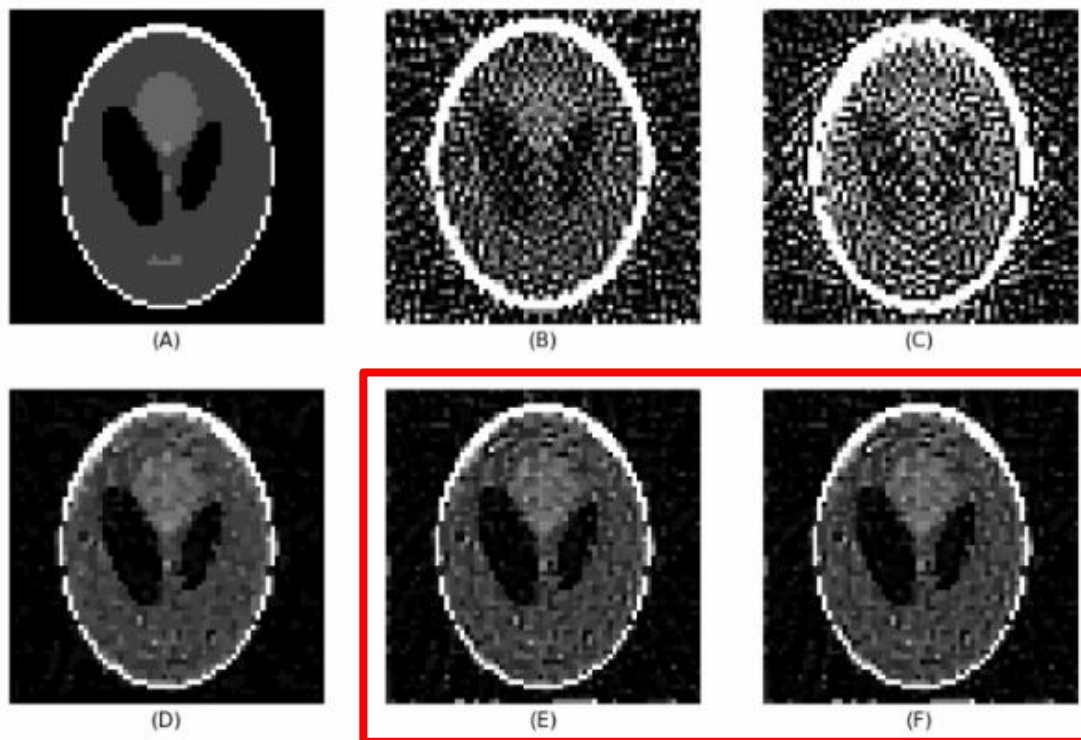


Image reconstruction results: (A) Ground truth, (B) FBP(common algorithm), mse=1254.14, (C) Basic gradient descent (conventional algorithm), mse=505.16, (D) Coordinate descent, mse = 6.74, **(E) Momentum, mse=6.36, (F) Adam, mse=6.09**

- ☐ Results are competitive with Coordinate descent (as shown in D)
- ☐ Adam and Momentum enable parallel sequence
- ☐ Faster convergence speed

- ❑ Continue the development and testing to demonstrate the use of ANN:
 - To accelerate CT image reconstruction
 - Use in CT reconstruction inverse problems to improve convergence and reduce computation time
- ❑ Explore other ANN algorithms
(E.g.: AdaGrad and RMSProp & other variations)
- ❑ Look for collaborative partners for development and testing to show accelerated CT image reconstruction

Iterative CT Image Reconstruction Using Neural Network Optimization Algorithms

(OTT ID- 1639)

For further information please contact:

Smruti Patil, PhD, IPMM
Licensing Associate
1440 East North Ave.
Milwaukee, WI 53202
Tel: 414-906-4657
smruti@uwmrf.org