Application of Google TPU-fined Adam Algorithm and Huawei NPU CANN Mindspore Toolkit in Physics-Informed Neural Network Training for Ptychography

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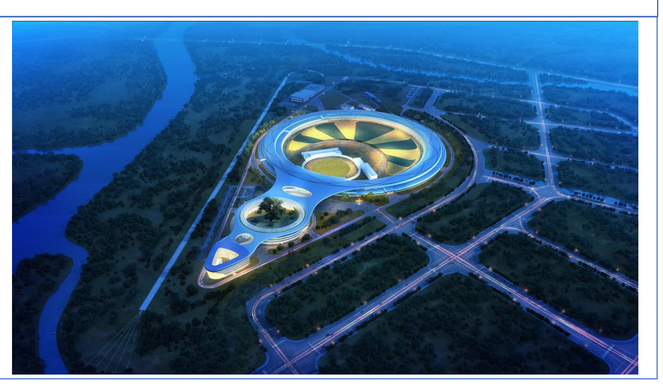
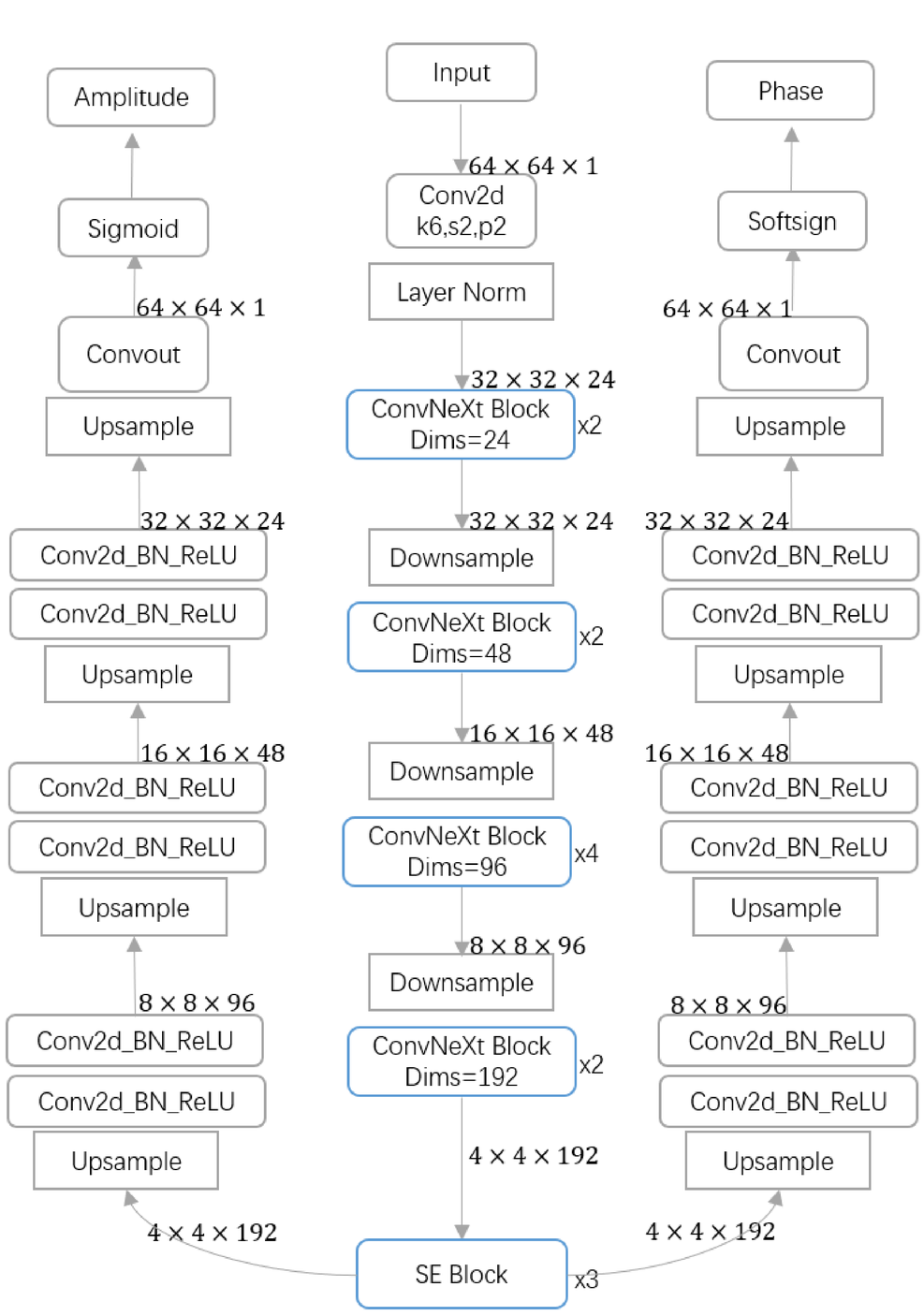
Why to Use Huawei NPU 910 for W1Net?

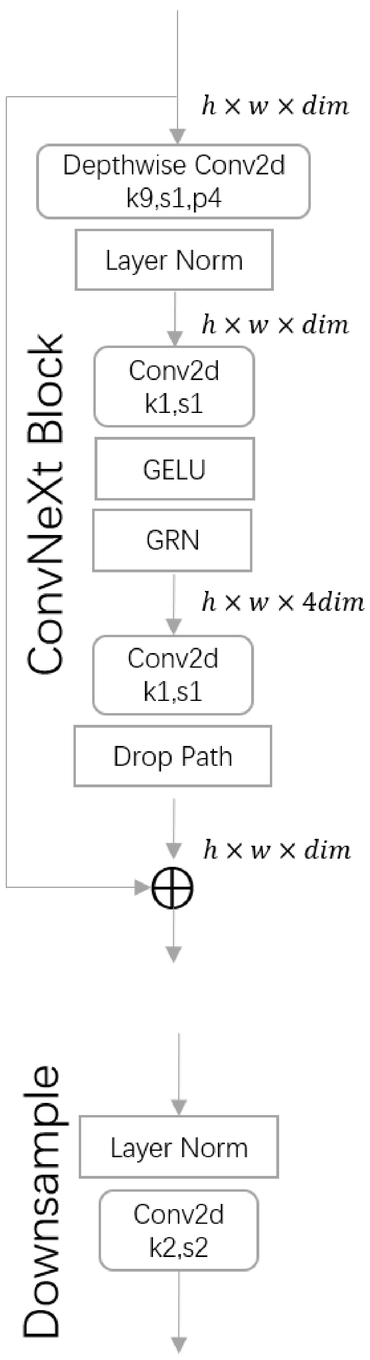
Ptycho-DM algorithm based on HEPS will generate more and more diffraction data

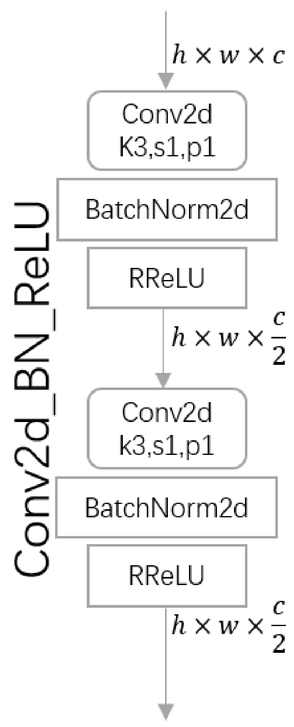
- The fourth generation of High Energy Photon Source higher X-ray throughput
- Eiger detector has higher resolution so the diffraction pattern data size is bigger
- Price of Nvidia GPU is getting higher so it is a better choice to use Huawei NPU
- AI algorithm like ptychoNN is better to inverse problem than ePIE or DM iteration method

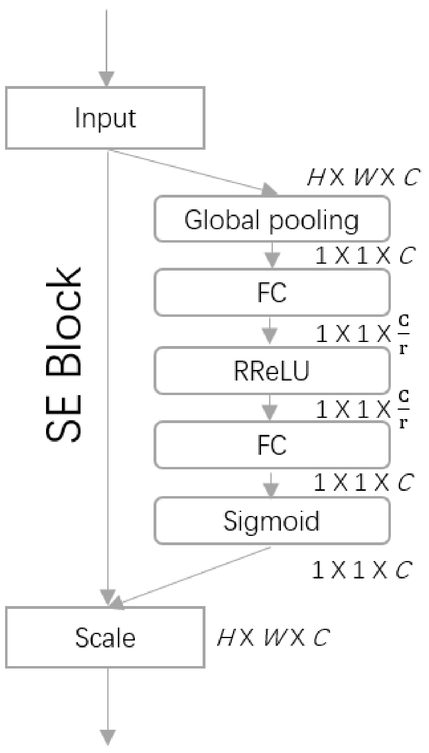


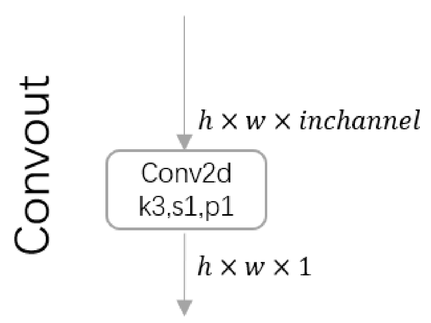
Details of W1-Net for ptychography reconstruction











Lion optimization Method

Evolved Sign Momentum (Google trained on TPU)

- Learning rate 3-10x smaller than AdamW
- Decoupled weight decay 3-10x larger than AdamW
- Advantage over AdamW increases with batch size
- Faster runtime compared to AdamW

Gradient Descent

$$w_t = w_{t-1} - \alpha g_t$$

Adam

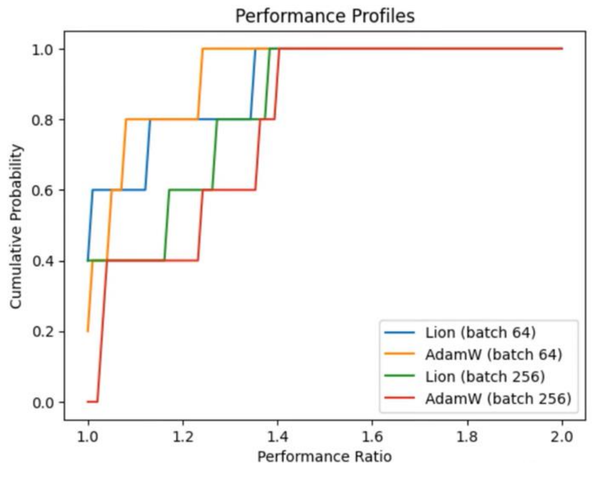
$$w_t = w_{t-1} - \alpha \frac{m_t}{\sqrt{v_t} + \varepsilon}$$

AdamW

$$w_t = w_{t-1} - \alpha \left(\frac{m_t}{\sqrt{v_t} + \varepsilon} + \lambda w_{t-1} \right)$$

Lion

$$w_t = w_{t-1} - \alpha \left(sign(c_t) + \lambda w_{t-1} \right)$$

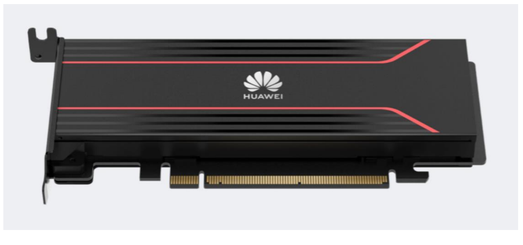


Huawei NPU 910 CANN

- CANN is AI-oriented heterogeneous compute architecture provides hierarchical APIs to help quickly build AI applications and services based on the Ascend platform.
- W1Net with Lion optimization operator training on Huawei NPU 910 is based on CANN and mindspore toolkit. Pytorch is developed by both Huawei and Pytorch team. 1/4 performance of A100.

CANN

Powered by Ascend



Huawei 910 DDP

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