Morpho Provides “SoftNeuro” to Highly Resolved Galaxy Simulations Project for Universities: Supporting 3D Simulation with Supercomputer Fugaku

Tokyo, Japan –December 5th**,** 2022– Morpho Inc. (hereinafter, “Morpho”), a global leader in image processing and imaging AI solutions, announced today that Morpho will provide its core product “SoftNeuro®”, the world's fastest deep learning inference engine, to a project promoted by the University of Tokyo, Tohoku University, and Kobe University to accelerate forecasting the expansion of supernova shells for highly resolved galaxy simulations using deep learning.
"SoftNeuro" will accelerate the inference of 3D simulations (galaxy formation simulations) using deep learning on the supercomputer Fugaku.

“SoftNeuro” supports major deep learning frameworks and performs faster processing in various edge-device environments. Since it is a general-purpose inference engine, it can be used not only for image recognition but also for speech recognition and text analysis. Morpho has proposed and provided "SoftNeuro" for multi-platform and high-speed inference for various detection applications based on image data.

For this project, Morpho has realized 3D CNN inference acceleration on Fugaku (SVE optimization of Conv3D and application of 3D Winograd) through the original development of "SoftNeuro" for use in 3D simulations. Through the project and collaboration, Morpho will support further acceleration of 3D simulations (galaxy formation simulations) using deep learning on supercomputer Fugaku.

About the Project
The project is to accelerate highly resolved galaxy formation simulations.
We have developed the 3D-CNN-based deep learning model that predicts anisotropic shell expansion of supernova (SN) explosions and identifies particles with small timesteps. Our model is based on Memory-In-Memory Network (Wang et al. 2018), which consists of 2D-CNNs and predicts future images.

“Our 3D CNN-based deep learning model predicts the expansion of SN shells within N-body/SPH galaxy formation simulations. We use the prediction results to decrease communication (data transfer) overheads, and by doing so we improve the scalability of our galaxy formation simulations. In the past, our 3D-CNN-based deep learning models have required extremely long inference time compared to the calculation time of real simulations on the supercomputer Fugaku. However, “SoftNeuro” enables our model to infer the result faster, making it practical in galaxy formation simulations.”
(Keiya Hirashima, Department of Astronomy, Graduate School of Science, The University of Tokyo)
Paper: https://iopscience.iop.org/article/10.1088/1742-6596/2207/1/012050/meta
Website: https://kyafuk.github.io/utokyo-hirashima/index.html

“Morpho has worked on optimization on SoCs for smart devices in the past, but through the 3D CNN acceleration of 'SoftNeuro' on Fugaku, we were able to take on the new challenge. I expect that the experience gained from this project will enable us to utilize our technology for optimization of 3D calculations and optimization on supercomputers in the future."
(Hitoshi Matsuo, Senior Researcher, CTO Office, Morpho Inc.)

With the growing need for faster and more efficient 3D simulations using deep learning, Morpho will continue to further improve the convenience and technical capabilities of “SoftNeuro” and develop technology on a global level to realize a fruitful culture through the provision of various services and solutions.

“SoftNeuro” product page: https://www.morphoinc.com/en/technology/sie

Related Information
Program for Promoting Research on the Supercomputer Fugaku
https://www.r-ccs.riken.jp/en/fugaku/org-relations/promoting-research/

Toward a unified view of the universe: from large scale structures to planets
(Junichiro Makino, Kobe University)
https://jicfus.jp/fugaku_ap/en/

Sub-project A: Revealing the Formation History of the Universe with Large-scale Simulations and Astronomical Big Data
(Michiko Fujii, the University of Tokyo)
https://jicfus.jp/fugaku_ap/en/research/subtask/subtaska/

Galaxy formation simulation using ASURA-FDPS
https://www.asj.or.jp/nenkai/archive/2021a/pdf/Z307a.pdf
(Takayuki Saitoh, Kobe University)

Abstracts of the Autumn Meeting 2022 of the Astronomical Society of Japan
Accelerating Predicting the Expansion of Supernova Shells for Highly Resolved Galaxy Simulations Using Deep Learning
Keiya Hirashima, Kana Moriwaki, Michiko Fujii (The University of Tokyo), Yutaka Hirai (University of Notre Dame, Tohoku University), Takayuki Saitoh, Junichiro Makino (Kobe University)
https://www.asj.or.jp/nenkai/archive/2022b/pdf/X52a.pdf

Related Press Releases
2021/10/20
Published: Research Paper on Accelerating Deep Learning Inference: The Technical Details of the Acceleration Method of SoftNeuro, Now Available for Free Trial
https://www.morphoinc.com/en/news/20211020-epr-softneuro_rp
* This free trial has ended.

About Morpho, Inc.
Established in 2004, Morpho is a research and development-led company in image processing technology. It has globally expanded its advanced image processing technology as embedded software, for domestic and overseas customers centered on the smartphone market, broadcasting stations and content providers. It has also provided image recognition technology utilizing Artificial Intelligence (AI), collecting image information captured by cameras into devices and clouds and analyzing it, for fields such as automotive devices, factory automation, and medical care. Morpho will provide broad support, making a wide range of innovations

happen with its imaging technology and Deep Learning technology. For more information, visit https://www.morphoinc.com/en or contact m-info-pr@morphoinc.com.