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RPPR Final Report
as of 26-Jan-2022

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Final Report for Period Beginning 01-May-2020 and Ending 30-Apr-2021
Title: Deep Learning Platform for High Performance Machine Learning for Automatic Target Detection and Recognition
Begin Performance Period: 01-May-2020 **End Performance Period:** 30-Apr-2021
Report Term: 0-Other

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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: 1 **STEM Participants:** 3

Major Goals: This project funded the acquisition of a Deep Learning Platform for Big Data (DLP-BD) with high performance data storage, networking, and processing capabilities to enable machine learning and specifically Deep Learning for ATR. The acquisition responds to the need for an in-house instrument enabling permanent storage of sensitive data that are in the tens of terabyte-range, and providing efficient big data processing through a non-volatile memory enabled hierarchical storage system, high speed networking interconnects, and multiple processors in parallel.

Accomplishments: During the past year, the acquired Deep Learning Platform for Big Data (DLP-BD) has proved crucial to our DoD project that involved developing algorithms for the detection, recognition, and tracking of targets (vehicles and dismounts) using InfraRed (IR) imagery. The main objective of this project is to support the US Army Advanced Targeting and Lethality Automated System , ATLAS, program.
ATLAS is a joint program, between the US Army C5ISR center and the Armament center. It aims to “develop autonomous target acquisition technology, that will be integrated with fire control technology, aimed at providing ground combat vehicles with the capability to acquire, identify, and engage targets at least 3X faster than the current manual process”. Our work in this area is in collaboration with the Army’s Night Vision & Electronic Sensors Directorate, and more specifically the ATLAS team.
The acquired DLP-BD have enabled local storage of large ITAR data and the adaptation, training, optimization, and analysis of various Deep Network architectures. Consequently, we have developed robust target detection and identification algorithms that continue to have excellent performance in various blind testing experiments.
The acquired DLP-BD is also currently being used to develop, train, and analyze a deep learning algorithm for door detection in an indoor setting. These efforts are part of a project that supports a small local company.

Training Opportunities: The PI and his Graduate Research students did not have prior experience in using a cluster of GPUs and accessing it remotely via VPN.
After acquiring the DLP-BD, our research team had to learn:
1) How to access the system remotely using VPN
2) How to code our algorithms to use a designated GPU

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Results Dissemination: The acquired system has been used to develop, train, and test machine learning algorithms that involve huge amounts of data and processing time for the following applications:
1) Automatic Target Detection and Recognition in Infrared Images using Deep learning algorithms.
2) Vehicle Make and Model Recognition using Deep convolutional Neural Networks
3) Detection of Buried Explosive Objects using Deep Convolutional and Recurrent Neural Networks
4) Detection of doors in RGB images of indoor setting. These research efforts are supporting a small local company that do not have the resources to solve this problem.

In addition, few undergraduate students (working as co-op in the PI-lab) are currently being trained to develop and test their code using the acquired DLP-BD. This will be very helpful to them as many IT companies are using similar systems for large machine learning projects.

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: The PI is involved in a DoD project that has benefited from the acquired system. The main objective of this project is to support the US Army Advanced Targeting and Lethality Automated System -ATLAS- program by developing autonomous target acquisition technology that provides ground combat vehicles with the capability to acquire, identify, and engage targets. Several algorithms for target detection and identification were developed, trained, and extensively tested using the acquired DLPBD. These algorithms have been transferred to the ATLAS team for further testing and analysis.

PARTICIPANTS:

Participant Type: PD/PI
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Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
National Academy Member: N

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Project Contribution:
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Project Contribution:
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This project funded the acquisition of a Deep Learning Platform for Big Data (DLP-BD) with high performance data storage, networking, and processing capabilities to enable machine learning and specifically Deep Learning for ATR. The acquisition has enabled the PI and his research team to have access to permanent storage of sensitive data that are in the tens of terabyte-range, and providing them efficient big data processing through a non-volatile memory enabled hierarchical storage system, high speed networking interconnects, and multiple processors in parallel.

The requested DLP-BD has significantly augmented the current research capabilities of the PI and allowed his team to conduct research in DL more efficiently. It allowed his team to design and train multiple networks for a several applications using very large data and gain insights in hours instead of weeks or months. This will advance their knowledge and contributions to areas that are highly relevant to the US Army. The requested platform has also contributed to the education and training through research of several graduate students in disciplines important to DoD missions.