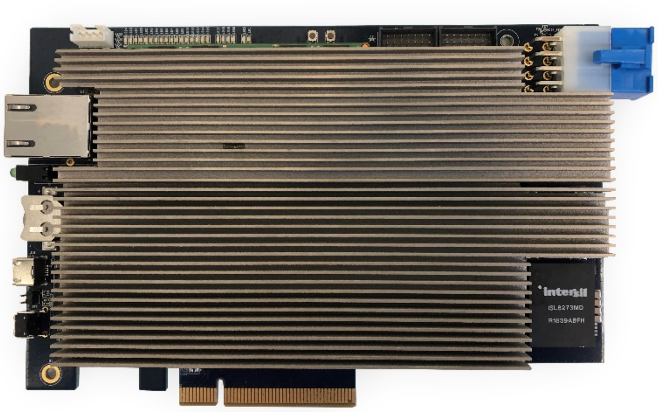
GSI Technology Takes On DSP With Deep Learning

Introduction

Over the last decade, deep learning has risen to become the state-of-the-art method for solving challenging problems in computer vision, natural language processing, and voice recognition. These advances have prompted researchers in other domains to apply deep learning to improve solutions to problems with well-established approaches. Digital Signal Processing (DSP) is one of these domains, and it is poised for disruption.

The GSI Leda-G® PCIe board leverages the GSI APU to improve existing algorithms in spectrum management and monitoring in both the commercial and aerospace industry providing innovative approaches to HPC requirements in next generation communication networks. Example applications include dynamic spectrum sharing and efficient beam forming. Applicable markets include the NIST deep learning technique that could help 5G select and share frequencies nearly 5,000 times more efficiently than current methods[1]; and applications similar to DARPA Spectrum Challenge that used deep learning to win the $1M prize[2]. The solution is applicable to commercial, 5G communications, and aerospace and defense applications.

GSI APU Board with Gemini® APU



Board Specifications	
Total board power	80W*
PCI IDs	Serial controller: GSI Technology Gemini® [Leda-G]
APU clocks	400 MHz
PCI express interface	Gen 3 x 8
Thermal cooling solution	Heat sink
Board dimensions	254 x 111.15 mm

Spec.	One Board	Multiple Boards
Maximum memory clock	2666 MHz	2666 MHz
Memory size	16 GB	N x 16 GB
Memory bus width	64 bits	N x 64 bits
Peak memory bandwidth	21.3 GB/s	N x 21.3 GB/s

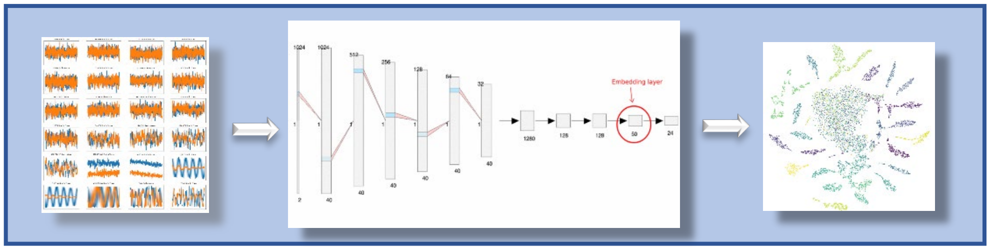
1 https://www.nist.gov/news-events/news/2020/05/nist-formula-may-help-5g-wireless-networks-efficiently-share-communications

2 https://www.cs.stanford.edu/people/dstavens/jfr06/thrun_etal_jfr06.pdf

RF Signal Classification

A 3-part design pattern that appears in several related applications blend deep-learning and nearest neighbor classification:

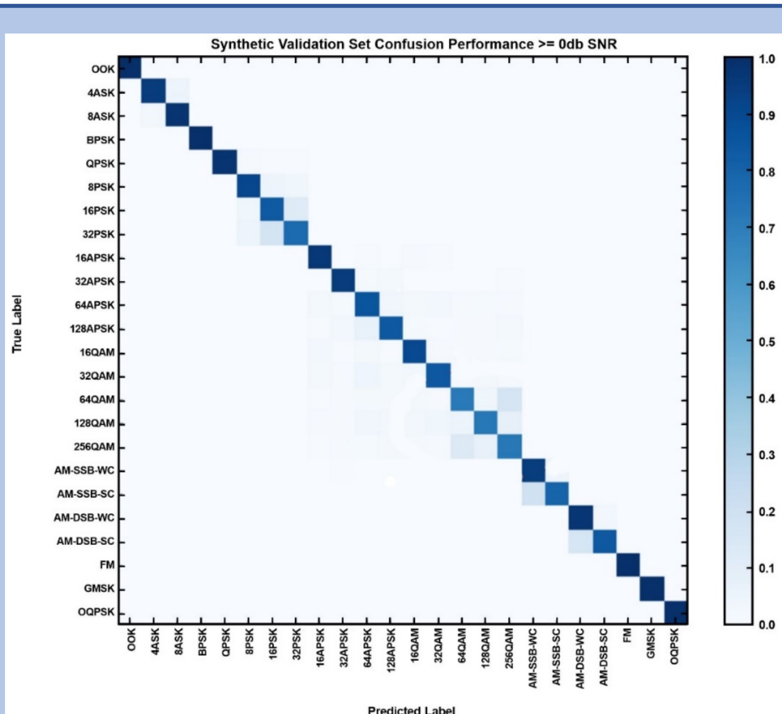
- ***Training***: A supervised, deep-learning model created from raw data (e.g., digitized known 1D RF signals). Done on GPU or CPU.
- ***Inference***: New queries converted to feature vectors using the trained model. Done on CPU.
- ***Similarity Search***: The query feature vectors are matched against a database of known feature vectors using approximate nearest neighbor. We subsequently apply KNN for classification. Done on GSI APU.

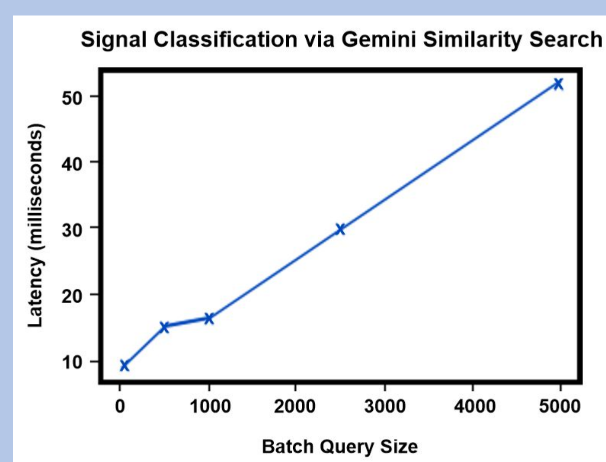


Performance

The following confusion matrix demonstrates the classification accuracy performance of our technique:

Latency is crucial for real-time DSP applications. The following graph demonstrates the batch latency of our Gemini chip for signal classification via similarity search. Notice single query and large batch query sets still achieve very low latency.





For more information on the Gemini® APU, please visit **www.gsitechnology.com/APU**.

For more information on Radiation-Tolerant needs, please visit **www.gsitechnology.com/Aerospace-and-Defense**.