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Machine Learning (ML) for Signal Detection

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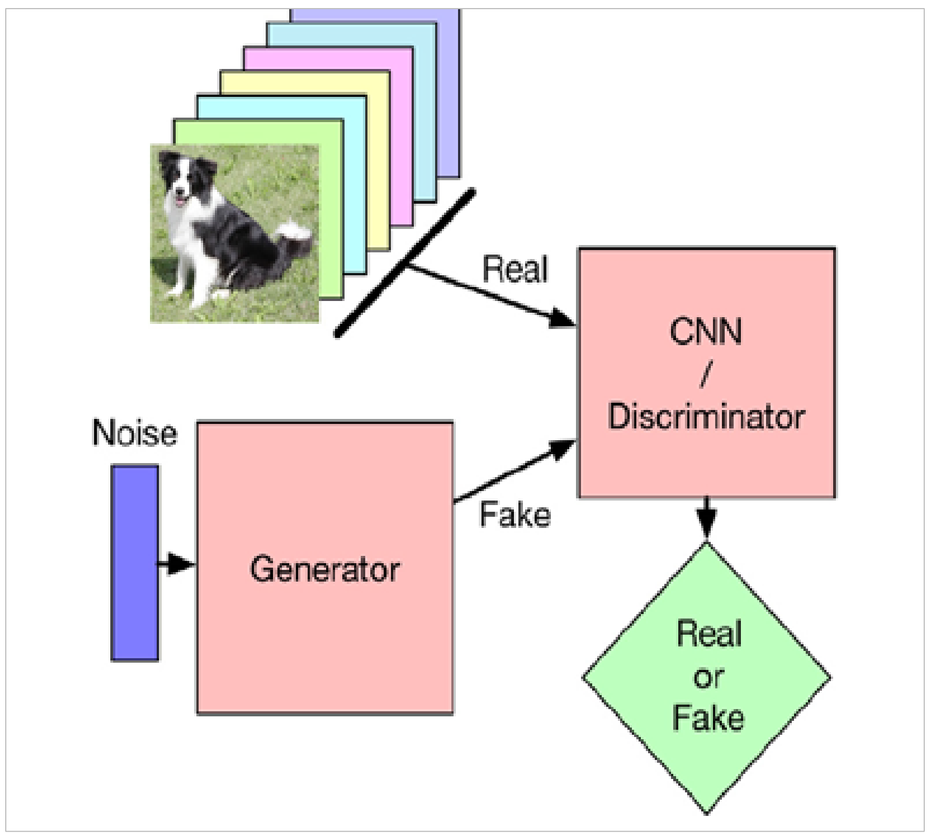
MACHINE LEARNING (ML) FOR SIGNAL DETECTION

Naval Postgraduate School

Motivation

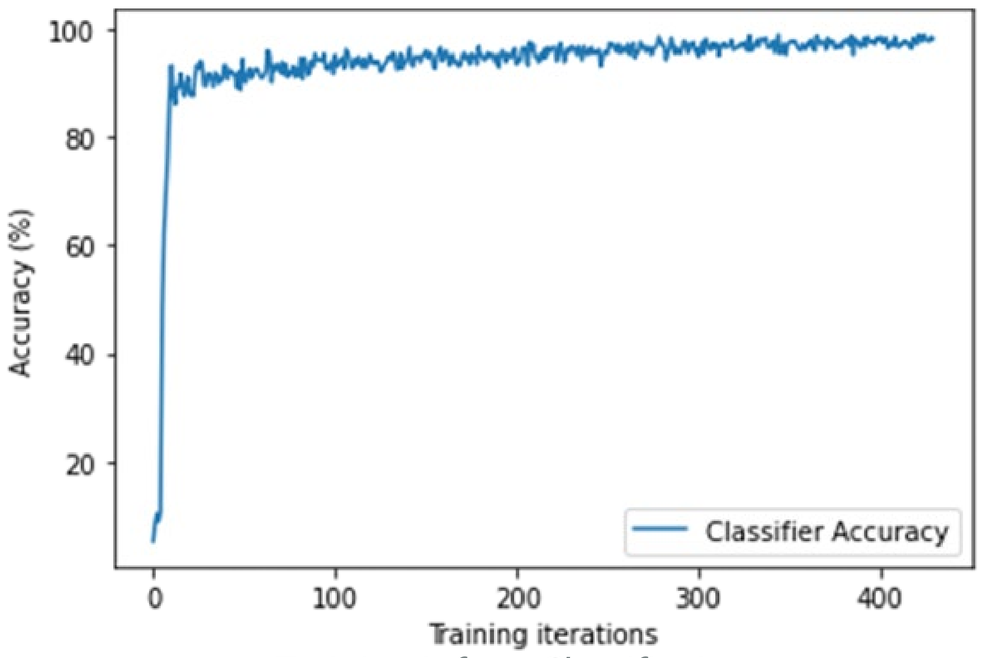
- US forces collect large sets of radio signals
- A small fraction of these signals have military intelligence value
- To search through the signal sets manually is time, cost, and manpower prohibitive
- An automated approach is needed



semi-supervised generative adversarial network (SGAN)

- Two Neural Networks
  - Generator & Discriminator
- Networks compete in min-max game
- labeled and unlabeled data used to train
- Generator creates fake data using noise input
- Generated data added to real data
- Discriminator determines if the data is real or fake

Discriminator Accuracy

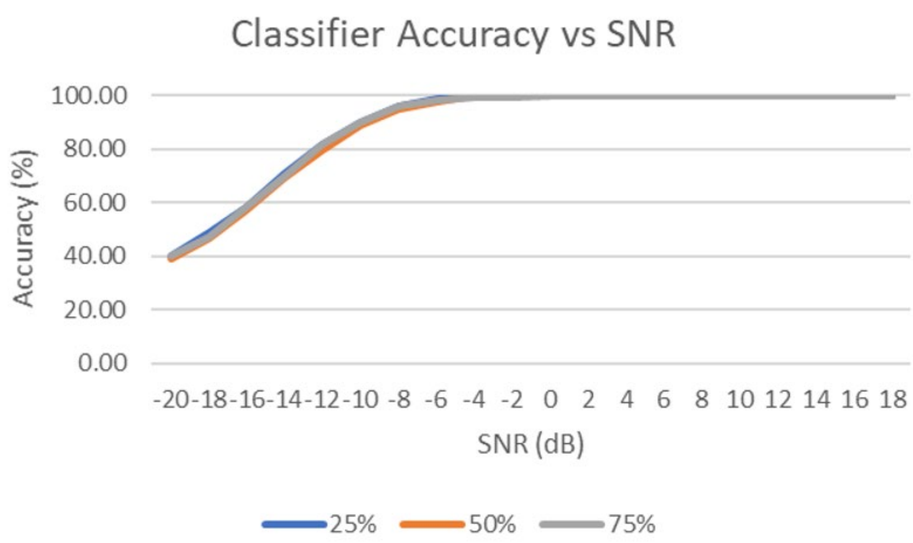


Training is fast. Classifier is accurate

- The discriminator accuracy is always a function of the training.
- In our case the discriminatory classifier accuracy for identifying signals of interest was very high, even few training iterations.
- This implies faster training, lower computing resource requirements, and quicker results.

Signal to Noise Ratio

- Classifier accuracy was very high for all practical signal to noise ratios and regardless of the amount of data used to train
  - For *SNR* > -4 dB.
  - For training with 25% or more of the data set.



Accurate at almost any practical SNR.

Conclusions

The SGAN performed exceptionally well at sorting SOIs within a large dataset using only pre-demodulated data and with minimal training times, thus providing the required automated approach.

The SGAN should be tested against data more typical of radio signal collections including center frequency offset, random initial phase, sample rate jitter, and multipath fading. The SGAN should be tested against radio signals collected over-the-air.

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