Machine Learning for Radar Imaging

Get involved: The Radar Imaging group at the Mathematics Department, NCSU, conducts research at the intersection of **two breakthrough technologies:**

A. Synthetic Aperture Radar (SAR) builds images using microwaves emitted from a satellite or aircraft. Digital signal processing is at the core of this technology. SAR is attractive because it can take images in any weather and any time of the day. Yet until the 2000's, only a small number of countries could afford this technology. Recent advances in hardware and software lead to an explosive growth in the availability and use of SAR instruments. Civilian and military applications include surveillance, change detection, monitoring of glacier movement and Earth subsidence, measurement of forest biomass, and many more.

B. Machine Learning has recently attracted attention due to its demonstrated performance in face and speech recognition, image classification, segmentation, network traffic monitoring, fraud detection, etc.

The Challenges in building **A+B** are two-fold. SAR images are **not nearly as common** as optical images (photographs) because SAR instruments are still relatively rare and the cost per image is high. The **high variability** of SAR images of the same scene originates from the physics of scattering of coherent microwave radiation as compared to incoherent illumination and much shorter wavelengths of the visible light. There are no datasets of SAR images comparable to ImageNet or CIFAR-10 in terms of the number of images per class. This is an obstacle to building the proper training sets in the area of SAR imagery.

What we do: We use statistical models of microwave reflectivity to build datasets of simulated SAR images. Then we apply Deep Learning to extract the parameters of the imaged scene. Our goal is to see how the techniques developed for optical images work with SAR images, and what kind of adjustments may be needed to accommodate this new type of imaging technology.

We are looking for students familiar with Machine Learning who will be interested in applying their knowledge and skills to a new class of objects. Basic understanding of mathematics of wave propagation and scattering is desirable but not necessary.

Interested? Join our group. Send an e-mail to Mikhail Gilman, `mgilman@ncsu.edu`, or Semyon Tsynkov, `tsynkov@math.ncsu.edu`. RA funding for PhD students may be available.

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